January 1961

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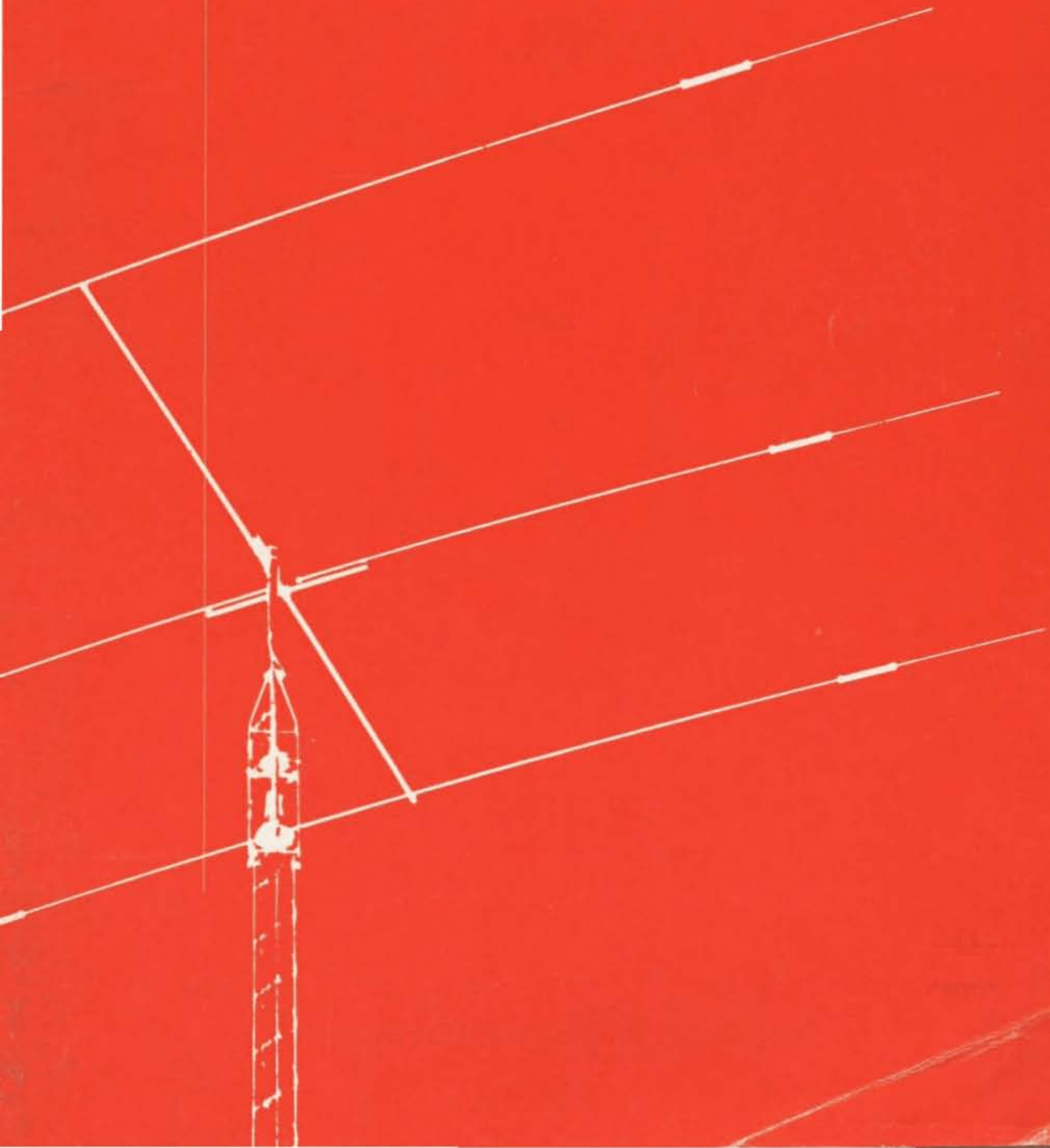
73

Amateur Radio



MOBILETTE 61, International's *new improved* all transistor, crystal controlled converter provides a "quick and easy" way to convert your car radio for short wave reception. MOBILETTE 61, units cover a specific band of frequencies providing a broad tuning range. Mobilette units are miniature size and quickly interchangeable.

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MOBILETTE 61, is available in a wide choice of frequencies covering the Amateur bands 75 through 6 meters, Citizens band, Civil Air Patrol

73 Magazine

1379 East 15th Street
Brooklyn 30, N. Y.

January, 1961
Vol. I, No. 4

Table of Contents

Nuvistor Converters for Six and Two .... Tom Lamb K8ERV 8
417A performance without 417A cost.

Down With Drift .... Jim Kyle K5JKX/6 12
Step by step stabilization of your receiver.

6N2 Completed .... Don Smith W3UZN 14
Eico, Heath and Johnson kits add up to 100 watts on Six and Two.

1296 mc .... Bill Ashby K2TKN 16
Secret confessions of a UHF addict.

Goblin Patrol .... Bill Lester W8UCY 18
Hams team up with cops to louse up Halloween for the kids.

Lost in a Tunnel .... Jim Kyle K5JKX/6 20
Pioneering frustrations of a diode speilunker.

8 mc Crystal Modification Kit .... Don Smith W3UZN 24
For thee who art long on 8 mc rocks.

Transistorized Frequency Standard .... Howard Pyle W7OE 26
Think of all the advantages.

Suction or Whoosh .... Paul Barton W6JAT 28
One is better, but you'll never know which unless you read the article.

Transistorized Communications Receiver .... Hans Rasmusen OZ7BQ 30
Just to show you what you can do if you really want to.

Vertical Radiator .... Howard Pyle W7OE 36
To warm the ether, not your shack.

A-M Detectors .... Staff 40
Our big technical article for the month. Guaranteed both interesting and informative.

Switch from the T-17 .... Roy Paffenberg 51
The fine art of surplus scavenging.

Propagation Forecast .... Dave Brown K2IGY 52
What bands what time to where . . . probably.

Spot Frequency Operation of VHF Nets .... Bob Kuehn WØHKF 54
How to herd everybody onto the same channel.

See-Saw Bleeder .... Pat Miller KV4CI 56
Save power and get better regulation thisaway.

Misc.:

Table of Contents 3
de W2NSD, Editorial 4
New Products 35, 50
Letters to Editor 49, 57, 61
Extremely Important Notice 58
MARS Technical Net Broadcasts 55
Other Ham Publications 63
Advertising Index 62
Cut Out and Send In Questionnaire 50

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COVER: W2MUM's Mosley beam as photographed by Joe Schimmel W2QDM.

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. . . de W2NSD

(Never Say Die)

WE'RE still completely embroiled in the mechanics of staying alive, worrying in turn about subscriptions, articles, advertisers, printing the next issue and (gulp) paying our bills. There are a few unavoidable diversions such as a chap who wanted us to help him get an FL8 license (he got it), a chap going to Zanzibar and wanted some gear (he got it), going to conventions (Miami on January 14th, Phoenix in May, etc.), talking to local clubs, fighting the flu (and losing), and trying to beat down a growing mountain of mail with my recalcitrant typewriter.

Helping Hands

A few fellows have really gone all out to let people know about 73 and to try to get everyone they knew or worked to subscribe. One of the most energetic is Ralph Morris, W1QUE of New Bedford, Massachusetts. Ralph sent in list after list of subscribers and put up his own money for the subscriptions, collecting it later from the other chaps.

Another bundle of energy is Don Smith, W3UZN, our Associate Editor down in Hagerstown, Maryland. There are many others that have helped tremendously too. Believe me we appreciate it and possibly might have not been able to get the magazine properly started without it.

If you are more interested in 73 and seeing it grow than perhaps just reading it over every month and then forgetting about it, then you can help. You can show it to your club members and talk them into subscribing. You can discuss our articles over the air and pass along our address to the interested. Maybe you'd like a sample copy sent to someone. . . just send us the name and address (we're printing a few extra these days for this). Perhaps you know one of the manufacturers who should be advertising in 73 and can pass a long some enthusiasm. You might be writing to a possible advertiser for some information and you could suggest that you'd like to see him supporting 73.

Most important of all are the advertisers who are presently supporting 73. They should be made rich and fat as a lesson to others. They will be very contented if you drop them a card asking for further information about their products. Before you shrug off the responsibility of this you should consider whether you like 73, whether you like the basic ideas which it represents, and if you think they are important enough you should take the time to help a bit. Please remember that though Brand X has five times our circulation the advertisers expect the same results . . . which means that the intrepid band of 73-ites has to be five times as active just to break even. Rally to the post cards, men.

Fearless Survey

Looking through the December issues of some of the more prominent ham magazines we find that the number of pages devoted to technical and construction articles runs about like this:

73 Magazine	33 pages
Brand X	28 pages
Brand Y	23 pages

Pacifists

Magazine reading is a pretty passive pastime and I suppose this has a lot to do with the tremendous inertia that I sense every time I suggest "doing" something. Like getting you to pepper the advertisers with encouragement or cast a monthly vote for the articles you like best.

How about taking an active interest? There are lots of things you can do. When you find a ham parts distributor that does not have any copies of 73 on the counter you could tell him about the magazine, suggest he order some counter copies, or drop me a card with his name and address so I can hound him about it. If you forget the address of the magazine just look up W2NSD in any Callbook.

Perhaps you know of some company that would do well to advertise in 73. If they have been advertising in other ham magazines you may be sure that I am after them . . . if not, then drop me a card with their name so I can send them information.

Now that home-brewing has dropped off to a shadow of its previous self we see few ads from component manufacturers. For that matter we see that many ham distributors have just about dropped their parts department. I hope that we can change the tide on this and revive a sweeping interest in home

Old Call Books

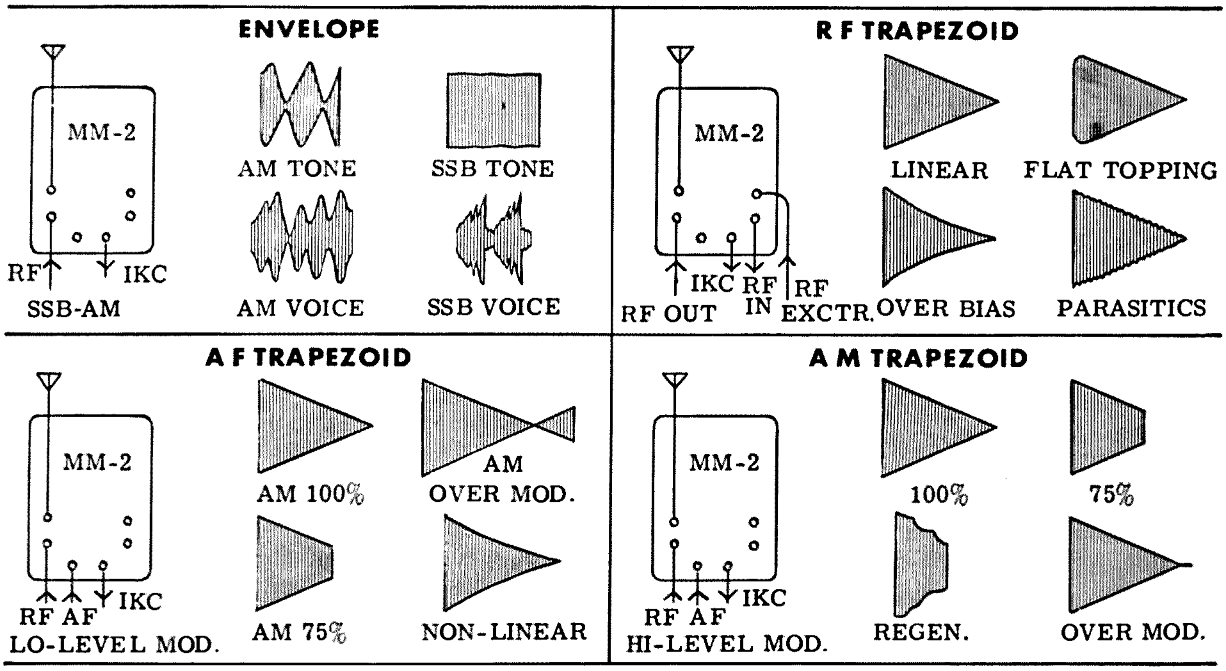
Few DX operators can afford to buy a Callbook. If you have one that is less than three years old that you would like to send to a DX ham then drop a card to Cliff Evans K6BX and he will send you a letter from a DX ham that would like to have your Callbook. K6BX, Box 385, Bonita, California. We think this is a wonderful service and extend our best regards to Cliff for his work.

THE MULTIPHASE MODEL MM-2
RF ANALYZER

- Monitors the RECEIVED and TRANSMITTED signals. Shows flat-topping, overmodulation, parasitics, keyed wave shape etc. Silent electronic switching keyed by transmitted RF.
- No tuning required. Broadband response flat 1 MC to 55 MC at power levels of 5 watts to 5 KW.
- New variable sweep control for transmit and receive.
- RF attenuator controls height of pattern. Calibrated in 3 DB steps.
- Function selector for ENVELOPE, TRAPEZOID and BOW-TIE patterns on transmit. For SSB, DSB, AM and CW.
- Built-in 1 KC audio oscillator, less than 0.5% distortion. With 3" scope, is ideal for complete alignment of SSB exciters.
- For use in series with 52-72 ohm coax lines. A short pickup antenna may be used with other systems.
- Plug-in adaptors available to match 50 KC, 60 KC, 80 KC or 455 KC receiver IF systems. Only one simple connection to receiver.

MM-2 Kit ... (less IF adaptor). $119.50
Wired ... (less IF adaptor). $149.50
Plug-in IF adaptors (wired only) ......
RM-50 (50 KC). RM-80 (60-80 KC).
RM-455 (450-500 KC)... ea. .. $12.50

THERE IS NO SUBSTITUTE FOR A SCOPE IF YOU WANT THE CLEANEST, MOST PERFECTLY MODULATED SIGNAL YOUR TRANSMITTER CAN PROVIDE. THE MM-2 IS BY FAR THE MOST DEPENDABLE and EASIEST TO USE, SINCE IT WAS DESIGNED STRICTLY FOR THIS PURPOSE.



OTHER FINE C.E. PRODUCTS

Model 600L	Broad-Band Linear Amplifier	$495.00
* Model 20A	Bandswitching SSB Exciter	$299.50
* Model 10B	Multiband SSB Exciter	$193.50
* Model GC-1	Gated-Compression Amplifier	$ 66.50
* Model B	Sideband Slicer with Q Multiplier	$104.50

* Also available in kit form

AND MANY OTHERS ... WRITE FOR LITERATURE

THE SSB PIONEER

MULTIPHASE EQUIPMENT

Central Electronics, Inc.

1247 W. Belmont Ave. Chicago 13, Illinois

A subsidiary of Zenith Radio Corp.

construction. Whoops, there I go dreaming again. Why do I always try to make the world over the way I want it, including stiff battles with City Hall. If I had any brains I'd see that old handwriting on the wall and print what everybody wants: a magazine full of tests of commercial equipment which tell you how great each item is. Get away from me with that straight-jacket.

Which Do You Like Best?

The votes are in for the November issue and again we find that every article in the book received some first place votes (by other than their authors). The winner this month is Tom Sowers W3BUL and his Transistorized 10 Meter Converter. A check has been sent as the winning prize. In second place by only a couple of votes was Jim Kyle K5JKX/6 with his $5 Frequency Counter. Our technical article for the month on noise limiters placed third. Tied for fourth place were Bill Hamlin W1MCA's Improving the Performance of the Gonset III and John Wonsowicz W9DUT's VHF Tri-Mode Receiver.
them to be of interest. Five articles will do. The winning author gets extra pay, see?

A Letter From Mama

Charlie Weaver (Cliff Arkett), frequently seen on the Jack Paar television show, was active on ten meter phone in the late 1930's as W6SGP (Sweet Grand Pa), engaging in long QSO's in the high, quavering voice of an old man. . . .*WØHKF*

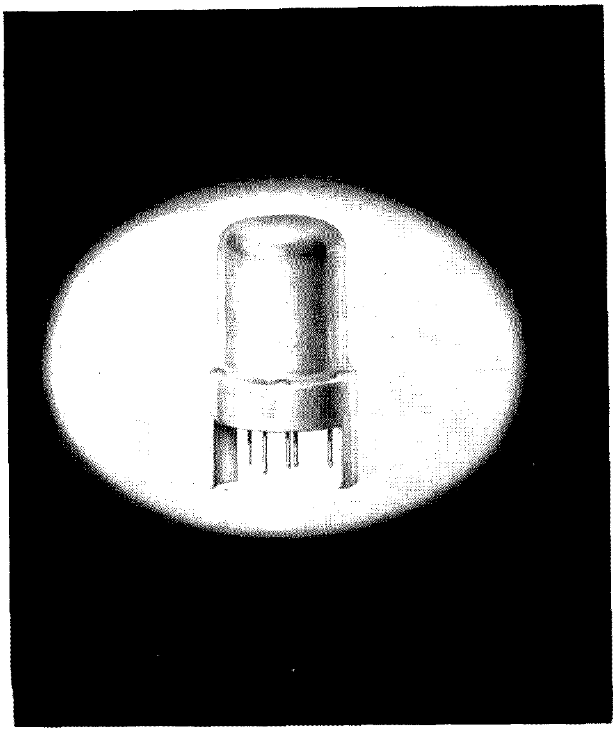
Long Live 50 Cycles

Much electrical equipment, including amateur communication gear appears on the market today still bearing the notation "for 50-60 cycles" despite the fact that the last part of the country of any consequence having 50 cycle ac was the Boulder Dam area, including Southern California. Through 1941 many W6 CW stations could be identified by the peculiar buzz on their notes resulting from the lower efficiency of their power supply filters at that frequency. The 50 cycle stuff did serve admirably as a standard reference for calibrating audio oscillators and frequency standards. . . .*WØHKF*

Lowering Crystals

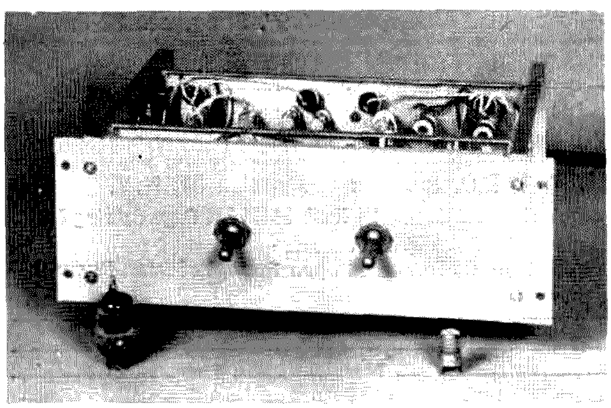
If you're looking for different ways to *lower* the frequency of a crystal try sodium silicate, sometimes known as 'liquid glass.' Available in drugstores and hardware stores at very small cost, successive coats can be brushed on or washed off as the case demands.

. . .*WØHKF*



Nuvistor Converters for Six & Two

Tom Lamb K8ERV
1066 Larchwood Road
Mansfield, Ohio



THE recent article on Nuvistors by Tilton[1] has created a great deal of excitement on the two meter band. Within a month of publication there were at least five low-noise Nuvistor preamps on 2 in Ohio, with their owners giving glowing reports of performance.

A small group[2] of Ohio amateurs interested in low-noise conversion recently met to check the performance of the 6CW4 Nuvistor on 144 mc. This group used three noise generators and three receivers (HQ-110, 75A-4, 2A) to check several 6CW4, 417-A, and commercial converters. The result was that the 6CW4 is as good, or slightly better than, the very best 417-A's, and is a considerably easier tube to use.

1. Tilton, "The Nuvistor as an rf Amplifier at 144 mc," QST, September, 1960, p. 38.
2. Those attending: W8SFG, W8LCA, W8WNM, W8QVK, K8MFZ, K8ERV.

(Here are a pair of compact converters that will give Meteor Scatter performance without hanging a mortgage on the roof. The heart of the circuit is a new tube designed for VHF service.)

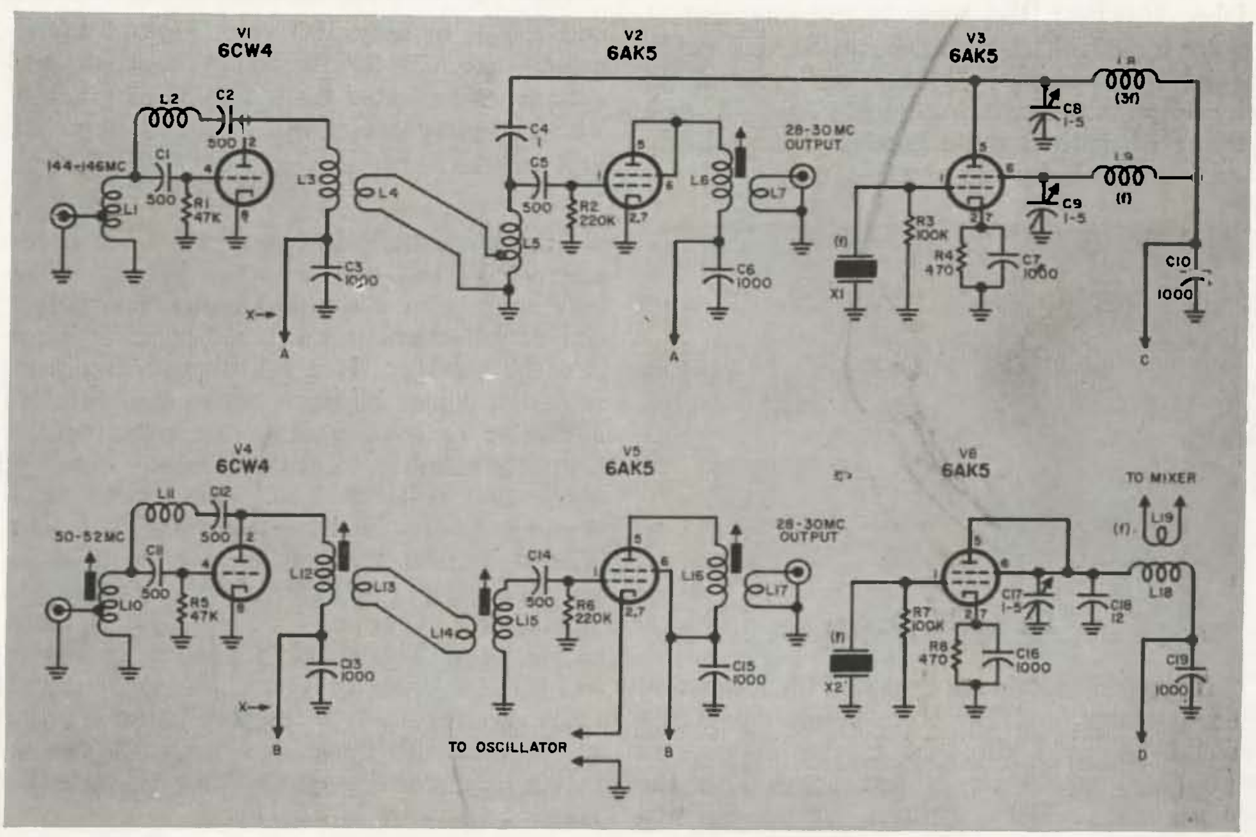
PARTS LIST

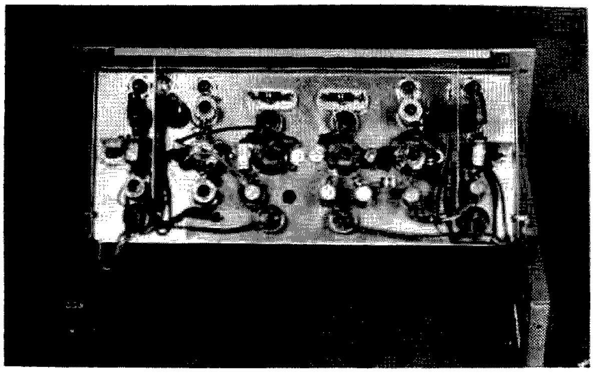
C1, C2, C5, C11, C12, C14—500mmfd ceramic (Erie GP-500)
C3, C6, C7, C10, C13, C15, C16, C19—1000mmfd silver-mica buttons (Erie FA-1000)
C4—1mmfd or twisted wire
C8, C9, C17—1-5mmfd tubular trimmer (Surplus-Barry #GC-35, 10¢)
C18—12mmfd NPO ceramic (Centralab TCZ-12)
C20, C21, C22, C23—1000mmfd disc ceramic
C24—40mfd 250 volt electrolytic
C25, C26—20mfd 250 volt electrolytic
R1, R5— 47k 1/2w
R2, R6—220k 1/2w
R3, R7—100k 1/2w
R4, R8—470 1/2w
R 9—500 2w
R10—3k 10w (depends on T1)
R11—100 1w
R12, R13—10k 2w (depends on T1)
V1, V4—6CW4 RCA Nuvistor (Socket Cinch-Jones) 133-65-10-001)
V2, V3, V5, V6—6AK5
V7—0B2
S1, S2—DPST toggle switch
D1—Silicon Diode, 600 PIV (Texas Instrument 2071)
T1—See Text
X1—Third overtone crystal, 38.66666 mc
X2—Third overtone crystal, 22 mc

COIL TABLE

L 1—5t #26 enamel on 1/4" polystyrene form, wind about 3/8" long. Tap 2t from ground end. Adjust by spreading turns.
L 2—Neutralizing coil. About 20t #30 on 5/32" dia. high value resistor. Close wound. Adjust by spreading turns.
L 3—Same as L1 but no tap.
L 4—1t link over L3.
L 5—6t tap at 2t, otherwise as L1.
L 6—26t #32 enamel on 1/4" slug tuned form, close wound. (CTC PLS6 form with green slug)
L 7—2t link over L6.
L 8—5 1/2t #24 enamel close wound on C8.
L 9—19t #32 enamel close wound on C9.
L10—16t #28 enamel tap 5 1/2t from ground. Same form as L6.
L11—Neutralizing coil. About 50t #36 enamel wound as L2.
L12—19t #28 enamel on same form as L6.
L13—1t link over L12.
L14—1t link over L15.
L15—17t as L12.
L16—Same as L6.
L17—Same as L7.
L18—25t #32 on same form as L6.
L19—2t link over L18.

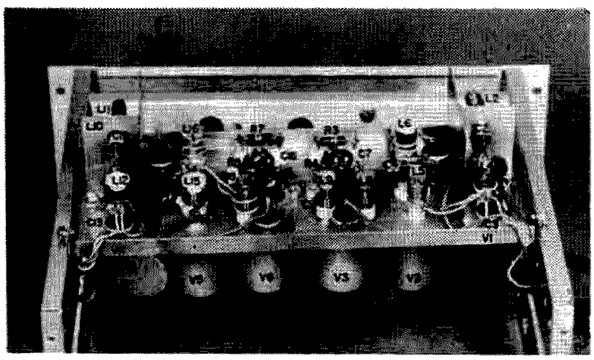
Note: In place of Silver-Mica button condensers, which are rather expensive, .001 discs mounted with short leads on a stand-off lug can be used will work just as well.





The lower transconductance of the 6CW4 (12500 umhos vs 25000 umhos for the 417-A) makes it more stable, with a small sacrifice in gain. While a high transconductance is usually thought to be essential in a low noise tube, actually it is the ratio of transconductance to plate current (among other things) that determines the noise figure of a tube. The very low plate current of the Nuvistor gives it a slight edge on the 417-A in the Gm/Ip ratio. The 6CW4 is probably the best tube presently available for stable, low noise amplification in a grounded cathode circuit. It is a thimble-sized, budget-priced paragon.

The group's very careful measurements gave the 6CW4 converters a noise figure of 3.2 ± .4 db. This is not a startling value when compared with the claims of some of the 417-A jobs. However, the accurate measurement of noise is difficult at best and can be very easily (and unknowingly) "helped out" several db by improper measuring techniques. A true figure of 3 db is quite good and is probably exceeded only by the exotic 416-B.



Converter Design

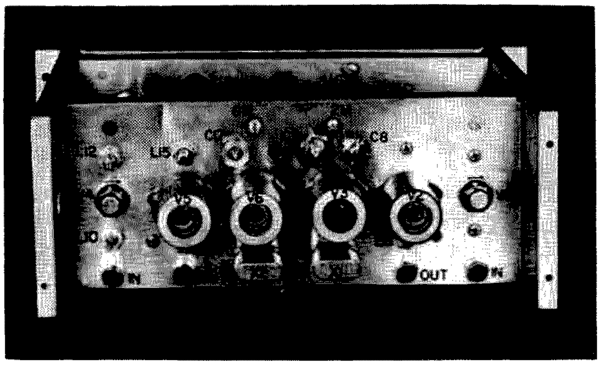
The converters were designed for low noise, compactness, and low cost. While the 6CW4 could be used throughout, the lower cost (surplus) 6AK5 serves just as well in the mixer and oscillator sections. The design was started backwards, with the oscillator-multiplier first.

The if

A 28-30 mc *if* was chosen for the two mc coverage found on most 10-meter receivers. The high intermediate frequency eliminates all image problems, and allows a simple broadband output coil to replace the usual cathode follower matching stage.

The Oscillator

A 38⅔ mc third overtone crystal oscillates in a conventional turned plate circuit, using the 6AK5 screen as a triode plate. The plate circuit triples to 116 mc. This very simple circuit generates a stable signal and sufficient mixer injection with a low tube dissipation



and a B+ of only 105 volts. *Initial adjustment:* tune C9 for maximum negative grid voltage as indicated by a VTVM at pin 1 of V3. The plate circuit will be tuned later.

The Mixer

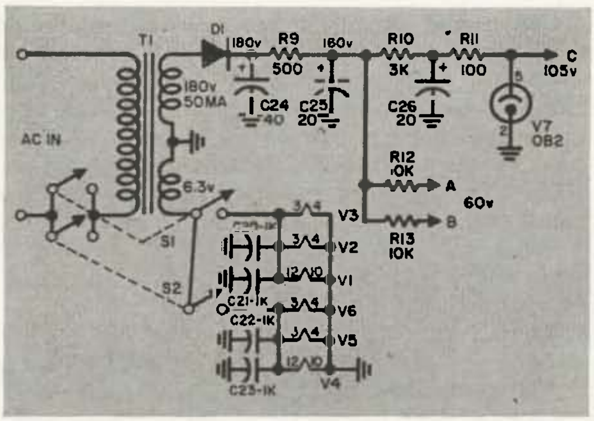
The mixer stage is conventional. A triode connected 6AK5 with grid leak bias gives low noise mixing in a simple circuit. The output coil is self-resonant for broad-band coupling into the receiver. If a full 4 mc bandpass is required, it may be necessary to load L6 with a resistor or by increasing the turns on L7. Capacity coupling from the oscillator develops about two volts of bias. *Adjustment:* Disconnect the B+ lead from the 6CW4 at point X, and connect a 28 mc receiver to the converter. With a VTVM on the mixer grid (pin 1 of V2), adjust C8 for maximum negative voltage. This should run about two volts, but isn't too critical. Now adjust L6 for maximum receiver noise, being sure you don't tune to the receiver's image frequency. If the receiver isn't sensitive enough to pick up mixer noise, L6 can be tuned later.

The rf stage is a "steal" from the K1IJB design. For all Ye Doubters, it can be shown both mathematically and by experiment that a *single* rf stage with a gain of 20 db or better is sufficient to swamp out the noise of even a moderately good mixer stage. Additional rf stages may increase the converter gain and bandwidth, but will not noticeably improve the noise figure, and may lead to overload problems. Any needed gain should be placed ahead of the receiver, not the converter. With anything less than a 2-meter kw in your block, the single rf stage should not produce cross-modulation *in the converter*.

The rf stage from L1 through L4 may be built as a separate preamp for an existing converter. Several have been built with close duplication of coils and performance.

Adjustment

With all previous adjustments roughed in, the rf stage is ready for alignment. With the 6CW4 B+ still off, connect an antenna and receiver to the converter and tune in a strong local signal. (A GDO may not work due to direct pick up in L3 or L5.) Roughly peak L3, L5, and L6. Now carefully spread L2 for a minimum received signal. The neutralization point will be a sharp and almost complete null. A few turns may have to be changed, but in all cases neutralization has been reached very quickly and easily.



Now reconnect the B+ lead and tune in a weak signal near the center of the desired tuning range. Peak L3, L5 and L6. L1 will tune so broadly that it may not seem to be effected by adjustment. Recheck the neutralization and secure L2 with Q dope. As a final stability test, insert an O-10 ma meter at X. The 6CW4 current should run close to 8 ma and should not drop when the antenna is disconnected at the converter jack. Any drop indicates oscillation of the rf stage.

If a noise generator is available, the input tap and L1 tuning can be further improved, but a 4 db noise figure was obtained with the above procedure.

The 6-Meter Section

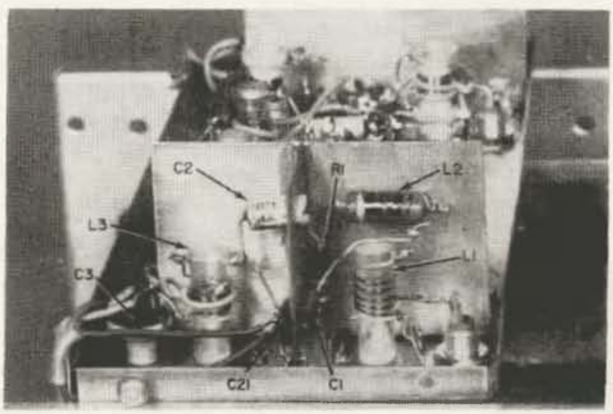
The six-meter converter started out with the circuit of the first two stages identical to the two-meter unit. The triode mixer immediately developed a few bugs. First, it was difficult to obtain enough injection coupling a 22 mc signal into a 50 mc tuned circuit. Cathode injection was tried with excellent results. Next, the mixer oscillated when L16 was tuned to 29 mc. Apparently the broadly tuned grid and plate coils caused some feedback at a common frequency. Changing to a pentode mixer solved this problem. The overall noise figure on six is 3 db, so the pentode connection does not contribute too much noise at this frequency.

The adjustments and operation of the six and two meter converters are identical. One caution—be sure to use iron slugs in the six-meter coils that are intended for use at high frequencies. The Cambridge Thermionic green and white slugs are rated for use in the 50 mc range.

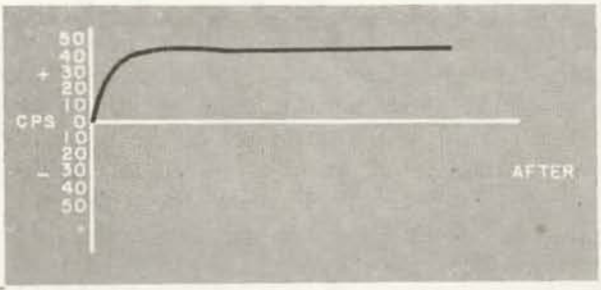
The Common Power Supply

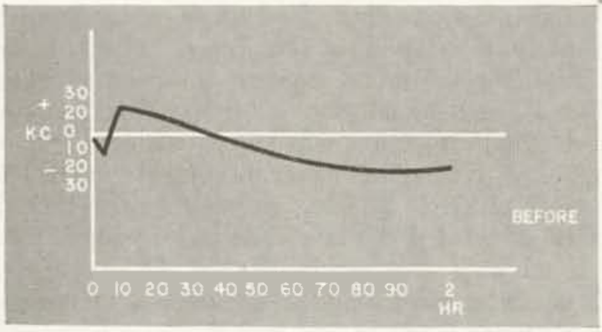
The power supply is conventional and will be described only briefly. The requirements of each converter are 60-70 volts at 10 ma for the rf and mixer stages, and 105 volts at 5 ma for the oscillator. The VR tube should be set to draw an additional 15 ma, for a total of 30 ma. A TV booster type of supply will power one converter, especially if the VR tube is omitted. For operating both converters at the same time a larger transformer is needed.

(Continued on page 50)



Down With Drift!





Jim Kyle K5JKX/6

These graphs show before-and-after performance of a BC-779 (Vintage Super-Pro) which was modified as explained in the text. Note that prior to modification, drift was measured in kilocycles, while after, overall drift was less than 50 cycles.

How's the stability of your receiver? Does it stay rock-like and steady where you tune it, or does it have a tendency to wobble and drift, thus necessitating retuning every few minutes for the first hour or so that you're on the air?

Chances are, unless you have a recent model of receiver—and one of the top-price models at that—that the rig could use some improvement in the stability department.

And if you should chance to ask, "Why bother? I can retune until it warms up," here are three good reasons for making that improvement:

In the first place, it's much more convenient to be able to tune once and stay there than it is to be continually touching up the adjustment.

Secondly, if you intend to utilize ultra-selective receiving techniques such as crystal filters, Q-multipliers, low-frequency *if* adapters, or audio filters, frequency stability is a must. The super-selective gadgets are a distinct hindrance if the received signal is wandering over the dial, even though they are a great help when the signal stays put.

Finally, in case you're interested in sideband, you will find that signals must stay put to be readable. Just 50 cycles drift when listening to a sideband station will make the voice sound unnatural, and very much more than this will make it unreadable.

Convinced? Ready to go out and trade off the old rig for a new super-stable receiver at a cost of half a kilobuck? Relax—you don't have to. Here are seven gimmicks to improve the stability of any existing receiver. Any of them can be used alone, or all can be combined. Naturally, the more you use the more improvement you'll get—but don't jump off the deep end too soon. Just three of them managed to tame a drifting Super-Pro down to an overall 40 cycles in the first hour!

The first two tricks involve no circuit changes in the receiver, so you might like to try them at the start.

Number One is an oldie. Since most frequency drift is caused by heat trapped in the receiver circuits, added ventilation will reduce the heat and therefore will also reduce the drift. The simplest method of getting more ventilation is simply to open the lid of the receiver cabinet!

Purists may not like the appearance of a receiver sitting in the shack, its cabinet lid open. They can place a small blower on the side or rear of the cabinet to achieve the same result at a much greater cost.

Trick Number Two isn't so basic or so elementary, but it can be a great help in taming an older Driftmaster.

In most of the better-class receivers, there is a centering-adjustment screw on the tuning

capacitor rotor shaft. This screw adjusts pressure at the shaft's rear bearing.

Proper adjustment of this screw will result in decidedly-lower drift. The object of the adjustment is to get the capacitor rotor plates in the exact center of their area between the stator plates. Expansion of the plates (caused by heat) will then have a much smaller effect on frequency of the local oscillator, since the distance from rotor to stator plate will be at its greatest.

To make the adjustment, tune the receiver to a steady carrier of known stable frequency (such as a broadcast station or WWV). Turn on the BFO and adjust for comfortable pitch. Now, without touching the tuning knob or BFO adjustment, adjust the screw for the lowest beat note. That's all there is to it.

The other five gimmicks all require some circuit modifications in the set; finish reading the article, then heat up the old soldering iron and prepare to dig beneath the chassis.

Number Three is also based on the heat-drift relationship and applies only to older sets which use metal or glass-octal tubes.

These large tubes have large elements, and are themselves a heat source. The large tube elements expand and change position as the cathode heats. This expansion results in frequency drift when the tube involved happens to be the oscillator.

The remedy is this: replace that big bottle with a miniature tube. The 6C4 is recommended as a replacement for any triode, triode-connected pentode, or strapped-grid converter tube such as the 6SA7 when used in the oscillator stage of a receiver. Except for changing the socket, no circuit modifications are necessary since all receivers operate this tube at ratings satisfactory for the 6C4.

The small elements of the 6C4 still change position with heat, but the amount of change is smaller and so is the resulting signal drift.

Trick Number Four is really a switch on Number Three, but is highly recommended for both old and new sets since it combines all the small-tube advantages with the additional bonus of a buffer stage.

Number Four is the twin-triode cathode-coupled oscillator. First described some two years ago by Leonard Geisler (who used a type 6SL7 and thus missed some advantages), this circuit may be substituted for the oscillator stage of almost any communications receiver.

Wiring of the stage is shown in Fig. 1. None of the parts values is particularly critical, but make sure that all leads are as short as possible and that all bypass capacitors are securely grounded.

If you don't happen to have a 12AT7 around, use a 12AX7, a 12AU7, or with modification of the heater connections, any of the cascode-type TV twin triodes. They all work nicely.

Number Five differs from all its forerunners. So far, we've been approaching the stay-put problem by trying to eliminate or minimize the effects of heat. Now, we're making a turnabout. We're going to use them.

Of course, it's not quite a complete turnabout, since we're going to be using them to counteract other heat effects.

What we're going to do it this: Install temperature-compensating capacitors at strategic points in the oscillator circuit to make heat effects cancel out as much as possible.

Since every receiver reacts to heat differently, no hard-and-fast formula can be given to help you find those strategic spots. A good place to start is right at the tuning capacitor frame. Use type N750 capacitors, and don't add more than 5 micromicrofarads if you can keep from it. In other words, if 5 mmfd doesn't do the trick, look for another place to put the capacitor.

Naturally, the capacitor's electrical connection will always be the same—in parallel with the oscillator section of the main tuning gang. Only its physical location may differ.

Closely allied to Number Five is Number Six. However, it uses no special component such as the temp-compensating capacitor. It is this:

Disconnect the leads from the cathode terminal of the oscillator tube. Then, between the cathode and any or all leads which were at the socket terminal, connect a 1,800-ohm composition resistor.

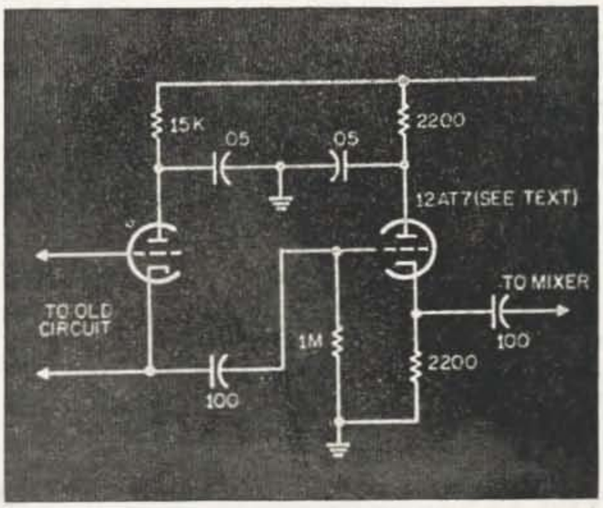
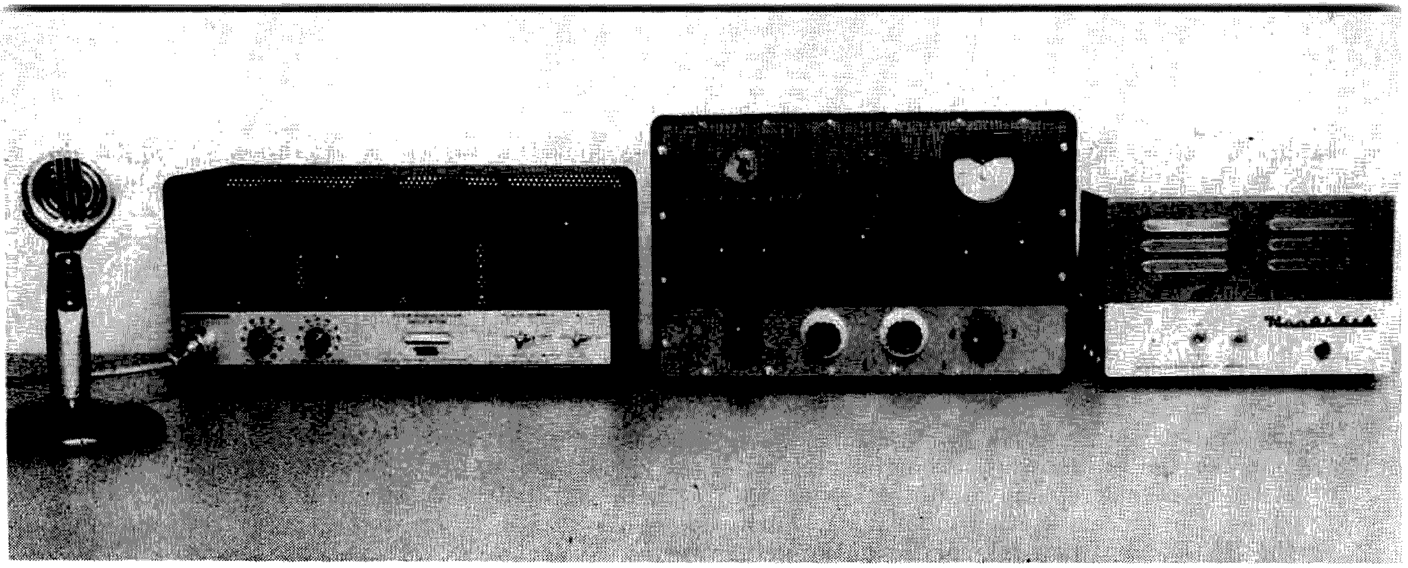


Fig. 1—This circuit, substituted for your receiver's present oscillator stage, will substantially reduce frequency drift. Parts values are non-critical, but lead dress must be direct and short. Use of a Vector 6-N-6T socket or an Amphenol type 59-369 socket will simplify wiring and installation of the stage.

The reasoning behind this gimmick is somewhat involved technically. Researchers at RCA Laboratories discovered it while investigating stability of TV oscillators in the UHF region. They report that changes in "cathode interface resistance" occur when supply vol-

(Continued on page 61)



Combining Kits for 100 Watts on 6 & 2

Donald A. Smith W3UZN
Associate Editor

How does a 100 watt 6 and 2 meter, crystal controlled transmitter complete with power supply and plate modulator for $200.00 sound to you? Good, eh? Using kit equipment manufactured by E. F. Johnson, Heath Company and Eico, you can build such a rig. These three pieces of equipment go together as if they were made for one another.

The transmitter section of the complete rig is the Johnson Viking 6N2. It uses the pentode half of a 6U8 tube as oscillator-doubler, the triode half as a tripler to 48-54 mc. A 6360 is used as a driver on 6 meters and a tripler on 2, driving the final amplifier which is a 5834 tube. The 5834 is an excellent choice for these two bands, running 100 watts input AM on both 6 and 2. A 6AQ5 is used as a clamper to protect the final. Efficiency is very good on two meters (where losses are generally very high), due to the use of silver plated tuned lines in the final The rig uses the common 8-9 mc crystals for both bands and has provisions for the addition of an external VFO. An 8 prong female socket is mounted on the rear panel for this purpose and has filament and proper B- available from it. (This voltage comes from the supply furnishing voltages to the rig.) The 8-9 mc output from the VFO is also connected to this socket. The Viking does not contain its own power supply or modulator and requires 600 volts at 200 mils., 300 volts at 70 mils., plus 6.3 vac at 3.5 amperes. 50 watts of audio is necessary to plate modulate the rig at 100 watts input.

As mentioned above, the rig has provisions for an external VFO. Johnson makes a unit especially for this purpose. It does not have a built-in power supply and requires the supply voltages brought out to the VFO plug. It covers 6 & 2 meters and sells for $34.95 in kit form and 54.95 wired. The National Company also makes a VFO for both bands which they call model VFO-62. It is available only in wired form and sells for $49.95. (This is a reduction of $20.00 as the unit originally sold for $69.95.) Another VFO is the Globe model 6-2, selling for 49.95 in kit form and 59.95 wired. I have used the Johnson and National VFO's with the 6N2, both with excellent results.

Your "Catalog Searcher" found the perfect answer to the power supply problem in Heath's UT-1 Utility Power Supply kit. The supply is rated at 600 volts at 250 mils. *or* 600 volts at 200 mils. *and* 300 volts at 100 mils., which is just what the rig requires! The supply also furnishes 6.3 volts at 8 amperes for filaments. The circuit used in the supply is the well known voltage doubler with large value input *and* output filter capacitors. Extensive filtering is used in the primary of the power transformer to reduce TVI. This filtering includes two line chokes and four bypass capacitors! A neon lamp is mounted on the front panel to indicate when the supply is on and both sides of the ac line are fused with 3 ampere fuses.

Catalog searching also turned up a 50 watt plate modulator kit manufactured by Eico (model 730.) The modulator is conservatively rated and contains the following tube line up. An ECC83 (12AX7) is used as a two stage

speech amplifier, a 6AL5 as a speech clipper, a 6AN8 as amplifier-driver feeding two EL34 power amplifiers in push-pull. An EM84 tube is used as an overmodulation indicator and a slow warm up, heavy duty GZ34 is used for full wave rectification, eliminating the need for an external power supply for the modulator.

The modulator has several desirable features. One is the clipper circuit (6AL5). This is a series type clipping circuit with adjustable clipping level. A filter is included in this circuit to suppress high order harmonics generated by the peak clipping. It is possible with this circuit to raise the speech level of the signal 8-12 db. Another feature is the output transformer which is multi-tapped, providing a number of output impedances, one of which is 3000 ohms, perfect for feeding the final of the 6N2. The over modulation indicator indicates over modulation when the modulator output signal exceeds the plate voltage of the rf amplifier. In this condtion, a negative voltage will appear at the grid of the indicator tube causing the indicator bars to overlap. The front panel of the modulator contains both gain and clipping level controls.

The Heath power supply must be modified, as it has only an off-on switch for ac power. A 6.3 vac, DPDT Potter & Brumfield relay is installed on the chassis of the supply in front of the large wire-wound resistor, as can be seen in the photo. A SPST toggle switch is also installed on the front panel, next to the ac off-on switch. This switch will connect 6.3 vac to the field of the relay when on, thus acting as the transmitting switch. The negative (B—), lead of the power supply is connected to one of the movable contacts on the relay. Both lower contacts are grounded. The B— from the modulator will also be connected to the relay (the other movable contact), so that when the relay is energized both the power supply and modulator will be on.

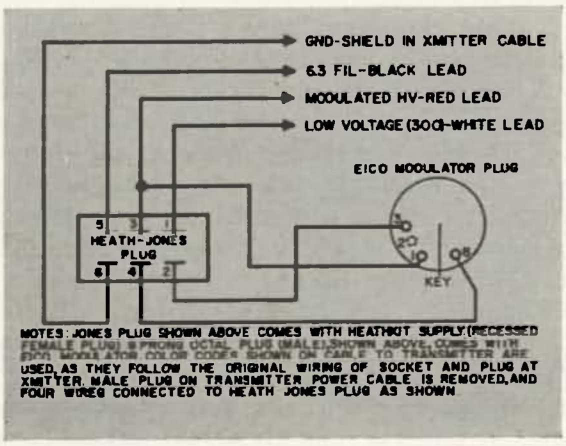


Fig. 1

The modulator has an off-on switch for the plate supply, located on the front panel of the unit. One side of this switch is ground so that the switch will ground the B— of the

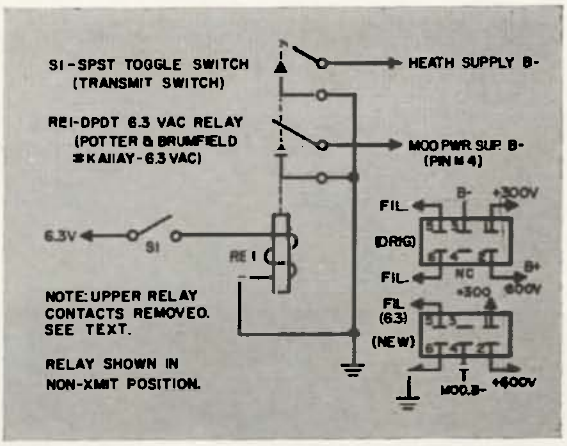
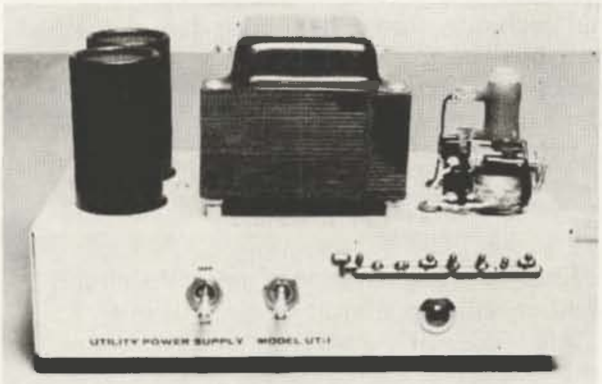


Fig. 2

supply when closed. For safety this lead is removed from ground and the wire from the center tap of the plate transformer connected to pin 8 of the modulator output jack is also disconnected. A lead is then run from this side of the switch to pin 8 of the output jack. A wire in the cable run from the modulator to the Heath supply permits the relay to control the plate supply of the modulator. The old plate switch of the modulator is now in series and must be left to the on position. If cw is desired, simply turn this switch to off and the relay on the Heath supply will only apply plate voltage to the rig and the modulator will be inactive. (See drawings.)



Power supply showing relay installed and extra (transmit) switch.

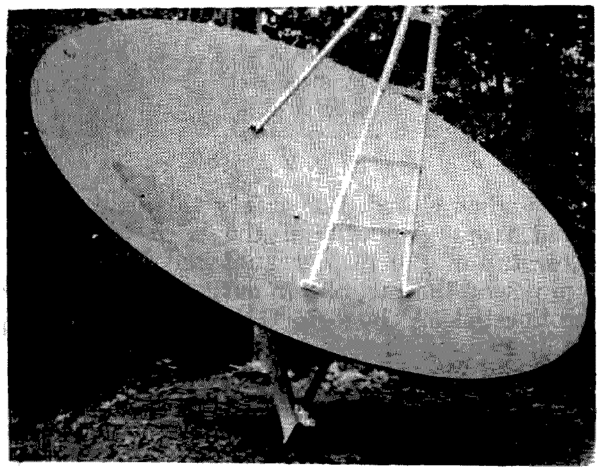
Note that a heavy ground strap (¼ to ½ inch), should be run from unit to unit and then to a good ground. This will prevent any of the units from being "Hot" and will provide a common ground return for all of the units.

Operating the complete rig is a real pleasure. The 6N2 is provided with a "tune" switch, permitting tune up without the final being in operation. This of course protects the final amplifier tube until there is drive available. After tune up, the proper modulation can be obtained by reducing the clipping level to zero and increasing the gain control until the indicator shows the two bars overlapping slightly when talking into the mike in a normal tone.

(Continued on page 59)

1296 Megacycles

Bill Ashby
K2TKN—AFA2TKN
Box 97, Pluckemin, N. J.



WORK on equipment for 1296 mc started here four years ago. It was immediately apparent that years of experience on 432 mc were not going to help much. Those circuits and techniques that had been found to work well on 432 mc would operate, but the efficiency on 1296 mc was terrible. There is as much difference between 432 mc and 1296 mc as between the BC band and two meters!

For Instance

Link coupling from one resonate circuit to another will result in at least 3 db loss.

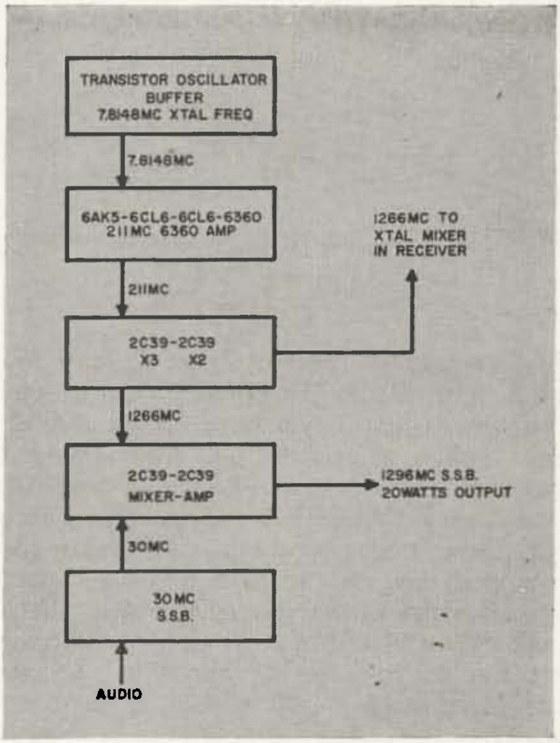
Solid dielectric co-ax of any type, size, or cost is useless. Eliminate all plans to use any amount, even a few inches for a flexible, twister section to the antenna or receiver. The losses at 1296 mc are horrible, and even a few watts will melt the line. Many have thought that with RG-17 or 19 and a short run, that they could keep their losses to about 2db—actual practice shows that true loss is about 3 times published figures, plus 3db of coupling loss. They end up with well over 6db loss in transmission—less than ¼ of the very hard to get watts from the Xmtr get into the antenna—and 6db of loss in receiving is a disaster. "G" line makes sense, but the lowest loss method is to mount all 1296 mc equipment at the feedpoint of the antenna. Use of 3″ x 6″ copper clad down-spouting is a wave-guide possibility.

UHF television transmitting tubes look interesting, but don't plan on results til you have seen the amount of rf output compared to the input! It is apparant that the 1200 to 1300 mc region is the dumping ground for odd resonances, sneak circuits, and resonant grid structures. 2.15 inches of metal or less from a low impedance point is infinity—and you cannot get rf from one point to the other. I have RCA-6161's and RCA 6181's operating on 1296 mc, but not at full power, or in circuits that an amateur would care to build. Both have good possibilities and can be obtained by trading your grandmother, for they are used in UHF television transmitters. The 2C39A is excellent, so are other planar triodes that have the grid structure straight across the grid ring. Grounded grid operation is a necessity, and stage gain is very low. Figure on at least four stages of triodes to get from the 10 watts output from a 3C39A doubler to the 300 watts of rf necessary to drive a KW input final! 2C39's need air, plenty of it, not only on the plate, but the glass to metal seals must be cooled, if reasonable life is to be expected. I have four 2C39A's in parallel in a barrel structure that will take 500 watts input and better than 30% efficiency. The blowers and cooling system are four times the size of the rf section.

The tremendous advantage of 1296 mc over any other frequency known is the possibility of hearing weak signals. The noise output of a good amateur-built receiver on 1296 mc will drop more than 15db when switched from a good 52 ohm resistor load at room temperature to an antenna looking at a cold portion of outer space. This means you can hear a signal that is more than 20db weaker than you can on 432 mc. Cosmic noise is low here, and amateur-built paramps can be made to work. After many hundreds of hours, acres of flashing copper, and weak eyes from re-reading every available article written on paramps, I am certain I know less now than ever about these machines of Mephistopheles. Don't even bother trying a 2K25 etc., Klystron for 3 cm pumping at 1296. At least 300 milliwatts of available power is needed from a 3 cm pump. 30 milliwatt klystrons work in well designed

paramps using a 3X freq. pump, but the extremely important problem of keeping the pump signal out of the mixer circuit is increased. A stable. controlled amplitude, pulsed test signal on 1296 mc is an absolute necessity for test and tuning a paramp! Dis-regard your pet circuits—build a transistor crystal oscillator —buffer on 7.8148 mc and bury it at least 3 feet in the ground; build a multiplier string that gives 162X the osc. frequency (3x3x3x3x2), and the resultant 1266 mc signal is the LO for your pet mixer circuit. Couple the crystal mixer thru a bi-filar coil tuned to 30 mc directly across the cathode of a 6AN4 grounded grid 1st *if*, and a reasonably stable, low noise 30 mc signal is available from the plate circuit of the 6AN4. Use of Varactors for the last two multipliers in the LO allows use of transistors thruout the oscillator—multiplier string, with plenty of injection signal at 1266 mc.

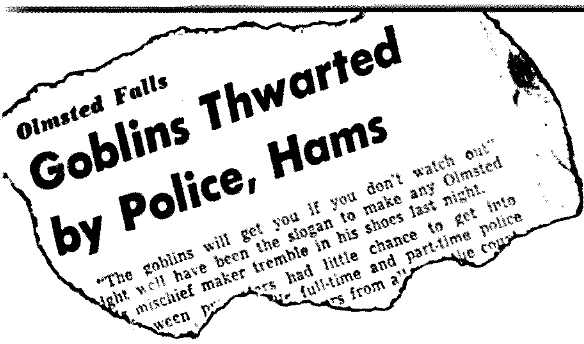
Antennas—be my guest! As a result of 4 months of hard labor by K2YUD, master welder; K2RIA, welder-owner; W2MHK. scrounger-deluxe; K2TKN, contributor of materials, elbow grease and design info; a 20 ft. steel parabola, of welded conduit tubing and covered with solid #24 gauge sheet iron takes up most of my back yard. It is still on the temporary mount, but by means of a 30 foot tower and a winch it can be pointed at any interesting portion of the sky and with much labor can be tracked on the moon as long as the beer holds out! When the weather is bad and given about 2 feet of snow, work may begin on the polar, motorized mounting. With Kraus handbook on antennas, 300 square feet of chicken wire, and a wooden frame, you will be in business. Yagis are impossible—bed-spring and square corner arrays work, and a slotted sheet holds possibilities.



When are you ready to start holding aurora and moon schedules? When pointing your antenna array at the Sun gives at least 6db raise in noise output from the tail-end of your receiver and you can burn large brown spots on your fingers with rf off of the antenna feed during Xmit.

(Continued on page 55)

Framework for 20-foot dish at K2TKN.


Olmsted Falls
Goblins Thwarted by Police, Hams

"The goblins will get you if you don't watch out" might well have been the slogan to make any Olmsted mischief maker tremble in his shoes last night.

Operation Gobiln Patrol

Bernard D. Ross
3941 Eastway Road
South Euclid 18, Ohio

Members of the Cuyahoga County Amateur Radio Emergency Corps made local news when they teamed up with Olmsted Falls police officers to put the damper on malicious Halloweeners. Led by Police Chief Don Shirer (W8QBF), the combined forces put three police cruisers and seven ham-equipped cars on the road to patrol specific areas and to cruise the community. "A kid can't even spit out of a window tonight without the police knowing about it," observed one high ranking city official, a twinkle in his eye.

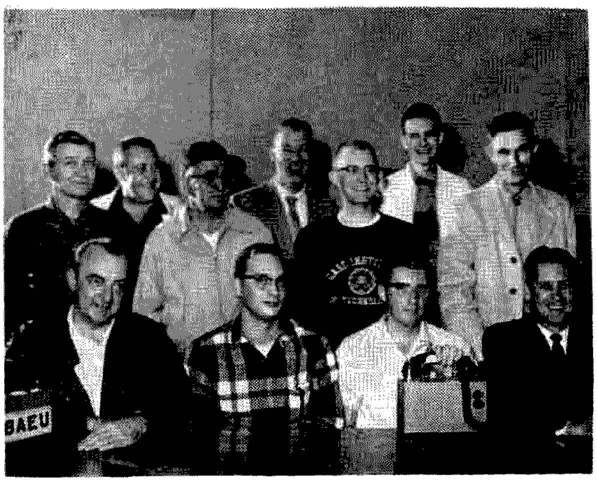
Hams served for the fifth year to augment the police normally serving that and two neighboring communities with a total population of 15,000. In the Olmsted Falls police station, the amateur master control station was located in the same room as the police master control. This arrangement allowed the desk officer to hear amateur communications and to relay the information immediately to one of the police cars on tour duty.

A police officer rode in each amateur's car, ready to serve as legal authority if required. Special emphasis was placed on points regarded as vulnerable; schools, a housing development with 400 homes under construction, shopping center, lumber company, and farmer's exchange. Not regarded as vulnerable and in need of no special attention on Halloween or the several days preceding was the graveyard. "It's never been bothered," said the Chief.

Last year a group of teen-agers set fire to kerosene-soaked corn shocks. Afterwards someone armed with a fire wrench opened a fire hydrant, and by the time the police arrived to close one hydrant, had opened three more elsewhere in town. An estimated 100,000 gallons of water were lost to the community that night.

Briefing the force is Olmsted Falls Police Chief Don Shirer (W8QBF). Front row, from left, are the chief, Sergeant Harry Powers, Policewoman Mary Powers, and Captain Ferb Bowen. In second row are Patrolman Lee Wurstner, Bob Fenderbosch, Francis Anderer, and Lester Sellers.

Ready to roll are (from left) Walt Ermer, W8AEU, Al Dolgosh, K8EUR, Ed. Schweikert, K8BUT, Ed Posey, K8KKO; (second row) Ahti Wahter, W8LHX, Art Cavar, K8JHZ, Bob MacLaren, SWL, Al Hollar, K8DPA; (third row) Chuch Jirsa, W8NZI, Glenn Bodeker, K8SBZ, and Prentis Drew, K8SPL.



A chilly day and early rain seemed to dampen the normally rambunctious spirits on Halloween this year, although police had reason to suspect trouble. Several sources reported that teen-agers were planning to start a fire, drawing the fire department and several police cars to the scene.

Then they expected to have free reign through the center of town. The report indi-

cated the youngsters intended to break windows of people they didn't like, destroy signs, and possibly damage the city hall, which houses both the fire and police departments.

Scouting around, a police sergeant found what appeared to be a pile of brush and debris, ready to be saturated with kerosene and set afire. According to the report, the fire was scheduled to be started between 10 and 11 P.M. Fortunately, and for some unknown reason, the rumored fire and later events never did materialize.

At a bridge repair site, youngsters stole 34 lanterns and more than 40 oil pots.

Three teen-agers, observed from patrol car, lounge casually in front of drugstore, apparently without a care in the world. A few minutes earlier, police came upon barricaded roadway to trailer park less than half a block away, saw youngsters running in direction of drug store.

Three 18-year old girls from a nearby community were apprehended with a carful of pumpkins taken from outdoor displays.

The roadway to a large-scale trailer park was blocked off by pyramids of cinder blocks, topped by signs reading, "Speed Limit—10 MPH," and "Peddlers and Agents—Keep Out."

Included in the patrol was Walter Ermer, W8AEU, Edison Award winner in 1959 for his organization and leadership of the AREC in Cuyahoga County. Said Walt, "We all enjoy it and the amateur acquires a much better knowledge of what our law enforcement officers contend with and vice versa. I think that only when the ham group is around on Halloween, do the officers have a really good time. We all have fun, and this type of activity helps train the amateur for the real emergencies when they arise."

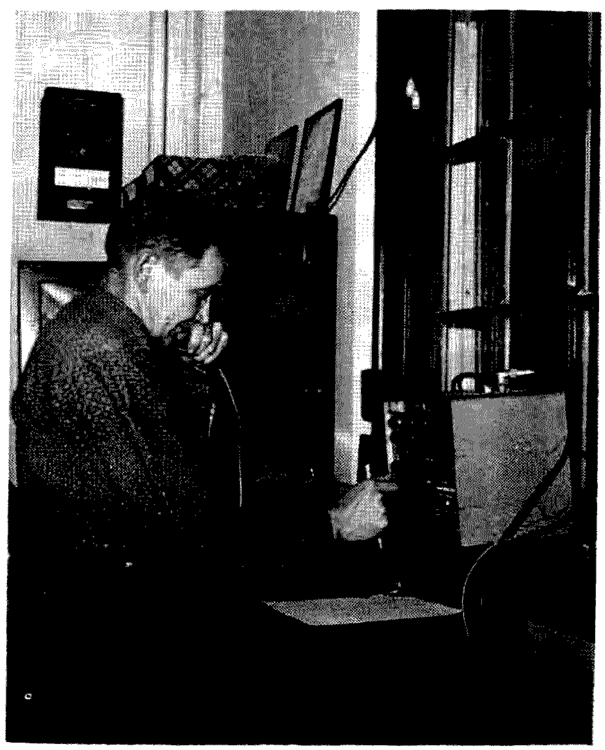
Ahti ("Ottie") Wahter, W8LHX, operated the 6-meter master control on Halloween. On preceding evenings, the patrol operated on 10 meters. Ahti is one of two amateurs who reports to the U. S. Weather Bureau for the thunderhead net in time of threatened severe thunderstorms of tornados.

Another outstanding ham in the patrol was Ed Posey, K8KKO, renowned for his rescue of 16 Valley View, Ohio, families in January of 1959. Ed volunteered and piloted his boat equipped with a 30-hp outboard motor to buck the current of the raging Cuyahoga River.

The amateurs on "Goblin Patrol" found much in the police group to appreciate and admire. Mrs. Dorothy Wurstner, wife of Patrolman Lee Wurstner, supplied and prepared an urn of coffee and three frosted cakes each of the four nights of patrol for the coffee break. Each of the police officers seemed more genial than the next, the geniality changing to firm tone and manner when it came to conducting police work.

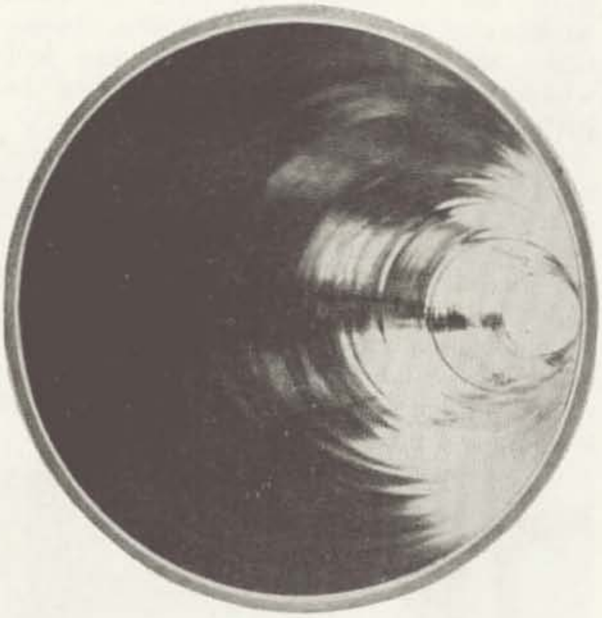
During the coffee break on Halloween, when the cars had returned to the station, someone managed to place a kitchen stove in the middle of Olmsted Falls' main street. Could he have had a receiver?

The 1960 Goblin Patrol ended at 12:30 A.M. It had been a quiet and relatively uneventful Halloween. Parting remark of one amateur as he turned to Chief Shirer: "Thanks, Chief. Invite me to your party again next year. **73**



Ahti Wahter, W8LHX, operates his 6-meter trasceiver amateur master control in the Olmsted Falls Police Station.

Lost In A Tunnel



Jim Kyle K5JKX/6
1851 Stanford Ave.
Santa Susana, Calif

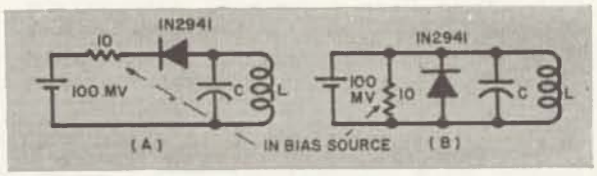
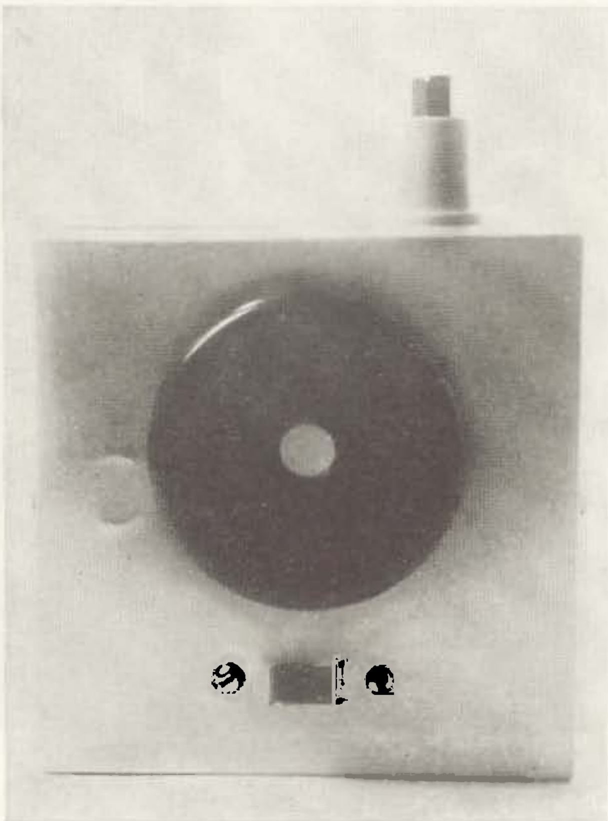


Fig. 1

OF the many new devices introduced into the electronics world within the past few years, none has captured the fancy of engineers, experimenters, and of course hams like the tunnel diode—that interesting little chunk of theoretically-impossible negative resistance which has nearly rewritten the book on semiconductor physics.

Shortly after the idea for "73" was born, this writer (half-humorously) suggested to Wayne that an article on "How To Build a

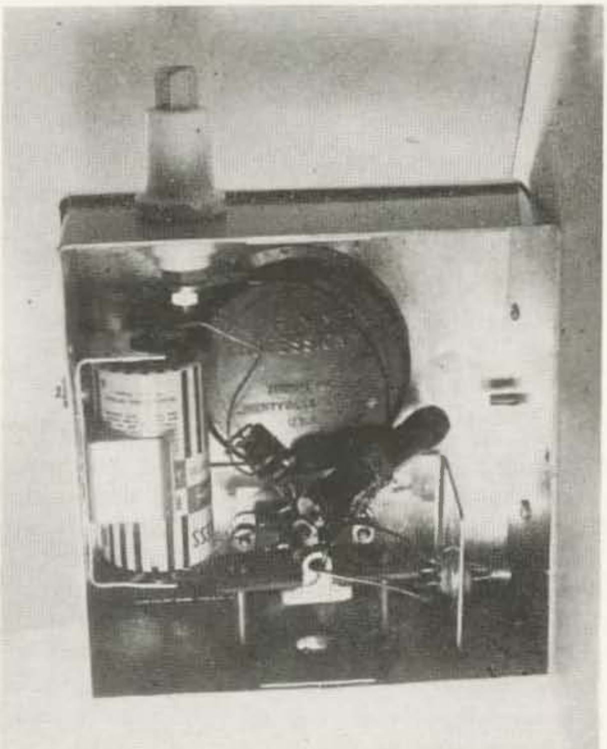


Head on view of front of rig. Box is 4 x 4 x 2.

Tunnel-Diode Transmitter" might be in line with the magazine's policy of bringing into focus the frontiers of amateur radio.

"Great!" was the answer from W2NSD. "Hop to it!"

The writer hopped. The only thing wrong was that this particular frontier seems determined to remain a soft-focus image. Whatever laws of classical physics fail to hold with the tunnel diode, at least one is proved truer than ever before: Murphy's Law No. 1—If in any project, any conceivable factor can cause the wrong result, it will!



Interior shambles. Messy look is due to short leads necessary for functioning of gadget.

Before going into the long story of how we got lost in the tunnel, let's say right here that this *is* a construction article. Before it's through, it will tell you how to build a tunnel diode transmitter that works. However, that's only a small part of the story, and if you want to stay out of trouble with the FCC, you'd better read it all.

As in the famed recipe for rabbit stew which begins, "First, you catch a rabbit," this instruction must begin with "First, get a tunnel diode." This isn't so hard as you might believe. Most major electronics parts houses catering to the industrial trade stock a few, and almost every manufacturer of semiconductors has at least one tunnel diode in the line.

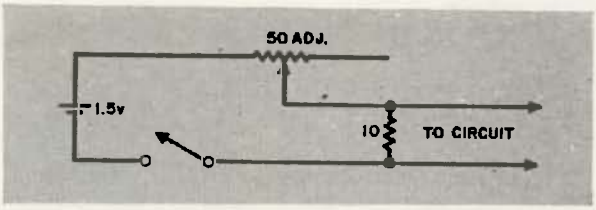


Fig. 2

One of the least expensive is the General Electric 1N2941, a 50-milliwatt, 5-milliamp unit which sells for $6.50 each in unit lots. You can buy 100 of them for $450, if you want your troubles in large doses. Others available for less than $15 include the Texas Instruments 1N653 and the Sony Esaki Diode (no type number) which sells for $10. The GE unit was used in this effort.

For a bit of background on the use of the gadget, see the July, 1960, issue of Radio-Electronics in which two GE researchers show how the negative resistance is achieved. A more scholarly treatment of the action appeared in the July, 1959, issue of the Proceedings of the I.R.E.

If you happen to read both these articles, you will discover that there are at least two ways to go about building a tunnel-diode oscillator, in theory at least. For convenience, we called these "Type A" and "Type B" circuits. They're shown in Figure 1.

Looking at the circuits, you see that the source of bias voltage—necessary for operation of the device—is specified as a 100-millivolt battery with zero internal resistance. Naturally, such a varmint doesn't exist. Obtaining such a power source (or at least, something which would look just like it to the diode) proved to be somewhat of a problem.

Fortunately, following the lead of the GE researchers, a circuit was developed which provides from 10 millivolts to 1.5 volts, with an effective 10-ohm internal impedance. It's shown in Figure 2. This bias-source circuit, without change, was used in both Type A and Type B oscillators and produced perfect results. However, there's a disadvantage—due to the heavy drain of the two resistors, the battery only lasts about a week. Be sure to disconnect it when the rig isn't in use to keep the battery alive longer.

Now to the long story. The first circuit tried was the Type A, following the lead of the GE people. With various inductance values inserted in the tank circuit—and omitting all lumped capacitance—fine oscillations were produced at several points between 12 and 20 megacycles. Modulation was accom-

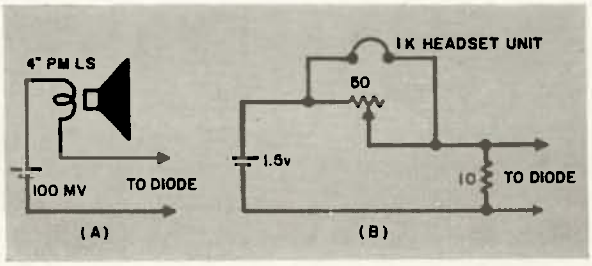


Fig. 3

plished as shown in Figure 3A, and the resulting FM-AM combination was copiable on a Super-Pro in the 25-kc bandwidth position although quality was definitely poor.

This original attempt might have resulted in the article in itself, except for one item: Murphy's Law. The inanimate objects proved their perversity, for the blame thing absolutely refused to oscillate within the borders of any amateur band. At 13.7 mc, yes. At 14.7 mc, yes. But between 14.2 and 14.35 mc, no indeedy! After a week's effort, project A-1 was abandoned and the Type B circuit was tried.

The Type B circuit evolves from experiments carried out in RCA's David Sarnoff Research Center. While the Type A arrangement places the tank in series with the diode, the Type B circuit places the tank and the diode in parallel. This makes them more tractable at SHF, although it has little effect at lower frequencies.

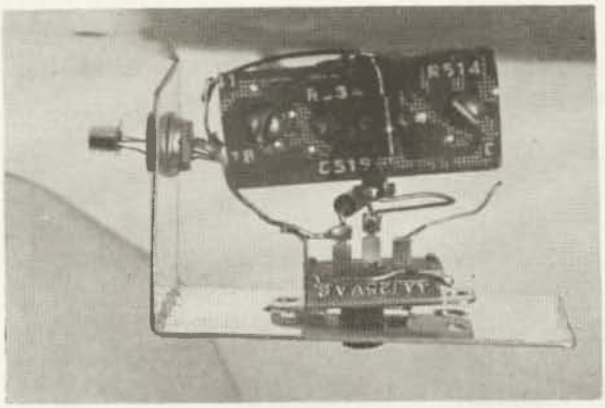
The target this trip was a 432-mc converter consisting only of a tank, a diode, and the bias circuit. An 8-inch strip of twin-lead was used for the tank, and the 10-ohm resistor of the bias supply was used to provide the short at the shorted end of the line. The diode was located an inch out from the resistor, and bias leads were run from the resistor through 1-uh rf chokes.

Like the preceding circuit, this one oscillated nicely with approximately 100 millivolts applied. When the Super-Pro's antenna lead was connected to the loading resistor (a zero-voltage point for the rf within the oscillator) any number of TV carriers could be obtained. Varying bias voltage between 70 and 150 millivolts tuned the oscillator across many, many megacycles. However, the signal from the grid-dipper which was simulating an incoming 432-mc signal eluded capture. After nearly 40 hours of searching with the receiver set in 3-kc bandwidth position, the signal was spotted—but promptly faded out when the dipper was moved more than six inches from the tuned line.

Sensitivity? Hardly!

Project B-1 went down the drain and the writer went to see the engineers.

After several weeks' study, during which a number of other versions were constructed, tested, adjusted, retested, and torn down, Project A-9 was put together. It was different from all its predecessors. It worked.



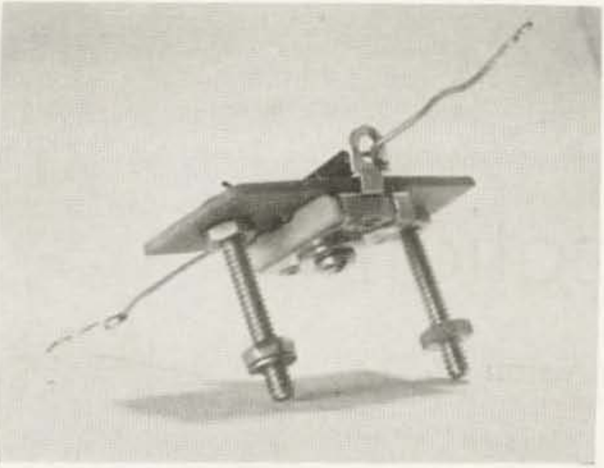
Main subassembly shown separately. Diode and those resistors not part of power supply are shown.

Since its circuitry also differs, drastically, it's shown in Figure 4. Note that no tank circuit exists, in the normal sense of the word. The engineers deduced that irregular performance of earlier models was due to excessive inductance which forced them to operate in the switching mode rather than as true oscillators, so the 20-ohm composition resistor was substituted. Its inductance is sufficient, in conjunction with that of the pigtails and the capacitance of the trimmer, to make the device operate in the range from 50 to 150 mc.

Modulation in this one is somewhat different, also, as shown in Figure 3B and 4. DC resistance of the headphone unit is high enough not to upset the biasing arrangement, and ac output is great enough to give a swing of nearly a megacycle in the 50-mc region—far too great to be used below 525.5 mc.

If you want to build one of these, duplication of the Figure 4 circuit is recommended as a starting point. It's far from perfect, but it *can* be used to amaze your friends, at least. With a few months more work, it can probably be developed into a reliable hand-carried portable good for up to a mile or so, suitable for CD and transmitter-hunt usage.

A standard 4x4x2 Minibox makes a good chassis, with a subchassis of light aluminum inside to hold the tunnel-diode socket and the



The tank circuit (also shown in No. 4). Capacitor is visible, resistor is partially hidden behind phenolic board. Incidentally, phenolic board was scrounged from old RCA printed circuit; this is reason for stencilled numbers on it which may draw questions.

switch. Wiring is straightforward, with one exception: DON'T CUT RESISTOR LEADS SHORT! While component leads should usually be short in VHF work, this rig uses their inductance for a tank circuit, and if you dress them in proper approved fashion, it probably won't work at all.

The big problem with this gadget is coupling of the antenna. If you have a perfectly-matched line which is actually a true resistance, it can probably be shunted across the 20-ohm resistor without effect. However, any reactance reflected into the circuit will be ruinous to its performance. Whip antenna and the like are out—every movement within 15 feet shifts the operating frequency a megacycle or more.

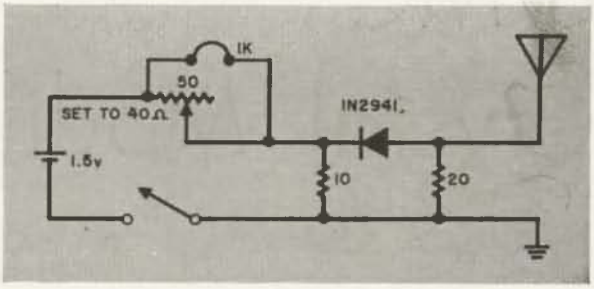


Fig. 4

This may sound as if the gadget is still far from perfected. You're right—it is. The only claim made for this gadget at the present time is that it produces modulated rf—about 1 volt of it peak-to-peak into a 1-megohm load. Location of this rf in the frequency spectrum is *not* guaranteed. If it falls within the bounds of any ham band, you're not just lucky, you must be the seventh son of a seventh son of a sev . . . The gadget, as hinted earlier, is notoriously unstable so long as any reactance whatsoever is in the vicinity —and this includes the variation in capacitance caused by the breathing of the operator. However, it does show promise, and that's why it's here.

Meanwhile, back at the madhouse, experimentation continues. Someday soon, model C-293 may produce more useable results. If not, you can still say you read about the battle first in . . . 73

"Mechanized Hole Cutting"

Roy E. Pafenberg

The problem of cutting large round holes in heavy steel rack panels has long plagued the amateur who uses this method of construction. Hole saws and Greenlee knockout punches have been used with varying degrees of success. Of course the hard way of drilling a circle of small holes and chewing out the remaining metal is used by many but this is extremely laborious and the results leave much to be desired.

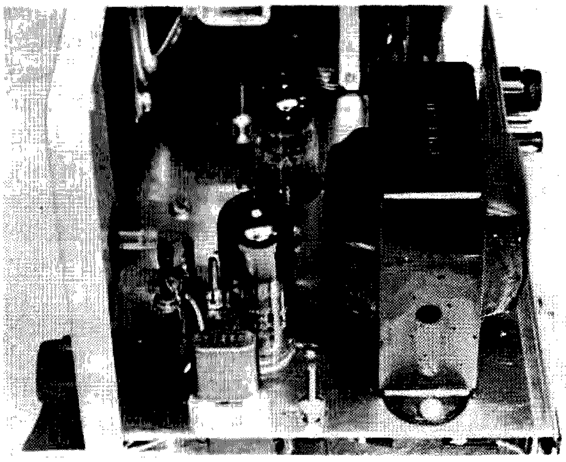
Electric impact tools, or wrenches as they are commonly known, are becoming more and more popular and are available with a wide range of attachments. The Greenlee hole punch becomes a formidable tool when powered by one of these labor saving devices. The comparatively light, rapid impacts of the tool drives the punch through the thickest metal with great rapidity. The wear and tear on the punch and drive screw is much less and the familiar problem of twisting off the drive screw is virtually eliminated.

These handy tools have many other uses and any number of drilling, tapping and threading operations may be accomplished in addition to that of nut driving. Use one and you will not be happy until you own one. ■

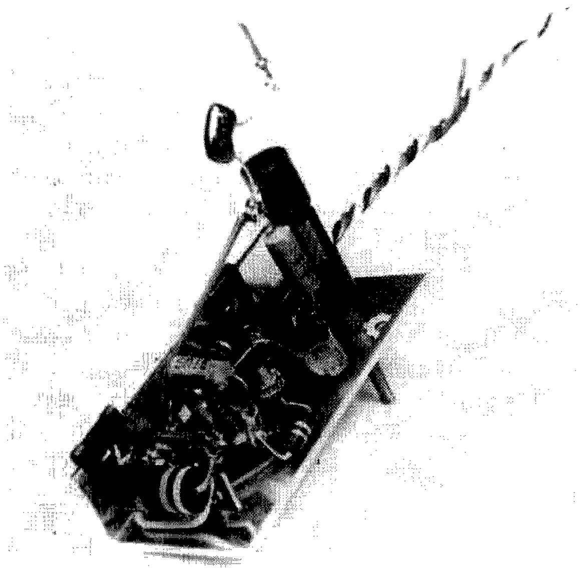
8 MC Crystal Modification

Donald A. Smith W3UZN
Associate Editor

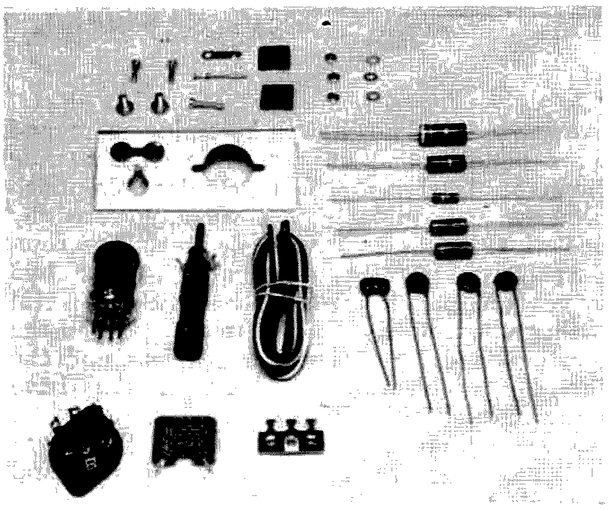
THE very popular Heath 6 meter transceiver can now be modified for 8 mc crystals, with Heaths new Modification kit, HWM-29-1. Following Heath's policy of improvement for existing kits, this modification has been released to all previous purchasers of the 6 meter transceiver for $4.95. This includes *all* parts, even the necessary hardware! All new HW-29's purchased will be shipped with this modification kit and the customer billed for $4.95. Kits shipped after the first of the year will incorporate this change in the main chassis and no modification will be required.



Close up of oscillator and xtal before modification.



Another view of completed chassis.

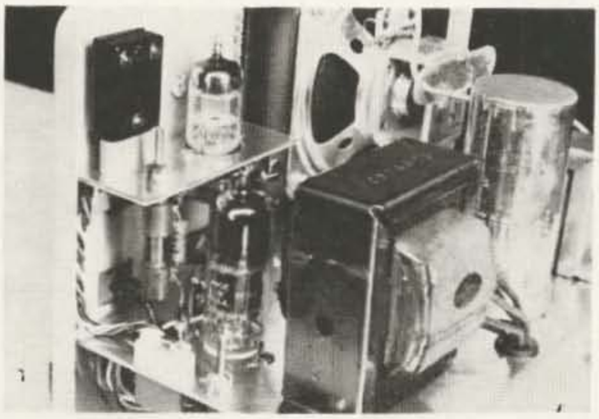


Parts furnished with HWM-29-1 Modification kit.

The advantages of this modification are numerous. Probably most important is frequency stability, which is improved for two reasons. First, the fundamental quartz crystals are inherently more stable than the fifth overtone types and secondly because the crystal oscillator is isolated from the final amplifier. Other advantages include; 8 mc crystals are *much* cheaper and more readily available than the overtone type. Power output is also increased, as the final amplifier operates straight through and has more drive than with the old circuit.

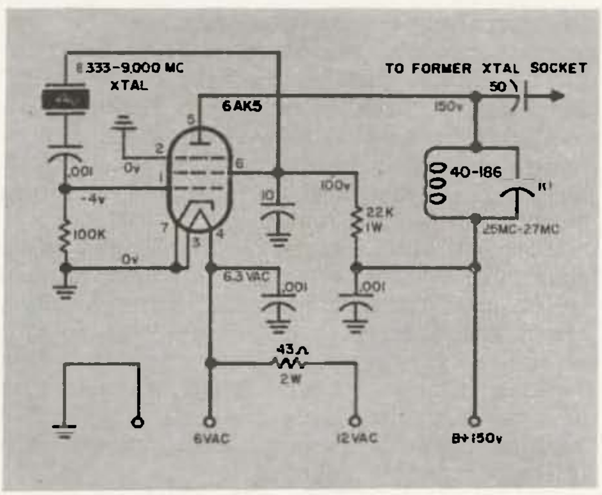
A modified Pierce oscillator circuit is used for the oscillator stage, employing a 6AK5 tube. 8.333 to 9 mc crystals are used in the grid circuit and the plate is tuned to the

third harmonic of the crystal. The output of the new oscillator is fed to the grid of the old oscillator stage, which now becomes a doubler stage. The new circuitry does not overload the ac power supply and one Heath vibrator supply is still ample to operate the unit while mobile.



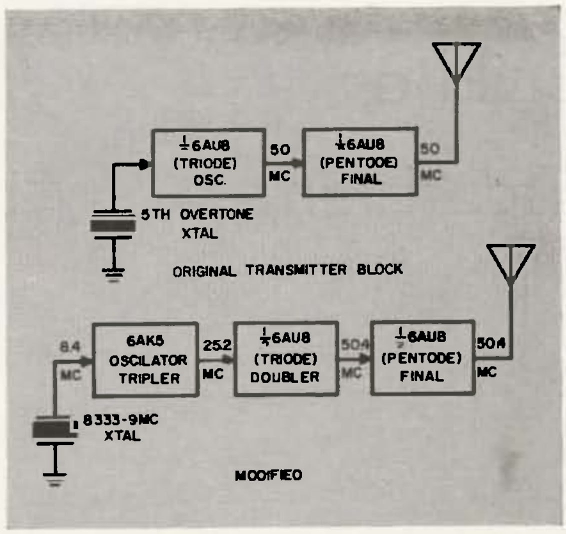
Close up of transceiver with new circuit installed.

One of the photos shows the parts included in the modification kit. Note that a miniature chassis is furnished and all new parts are mounted and wired on it. The new crystal socket for the 8 mc xtals is mounted on one end of this chassis and takes the common FT-243 size. Complete instructions for wiring the new oscillator circuit are included, as they are with all Heath kits. It is necessary to drill two holes in the front panel of the transceiver to mount the new chassis. A template in the manual simplifies the layout of these holes. The photos show the unit completely wired before installation in the unit so that you may see the wiring.



Circuit diagram of new, added circuit.

No difficulties were encountered in the building or installing of the modification kit and it required about an hour or so to complete the job. The real enjoyment began when an 8.4 mc xtal was installed, 6AK5 placed in its

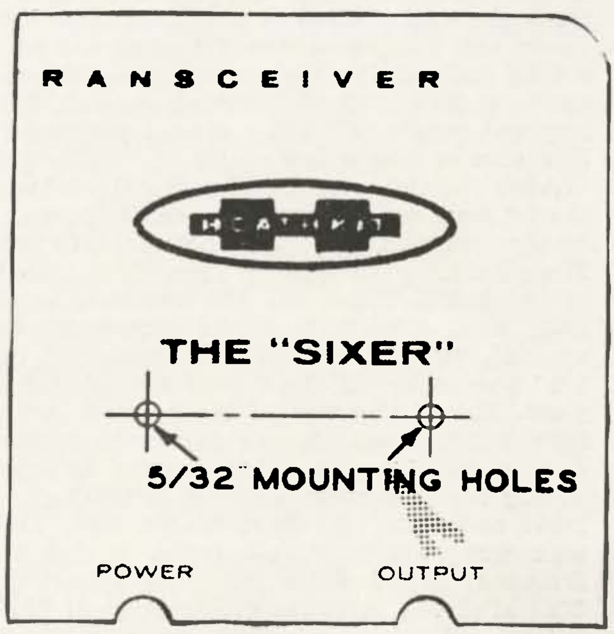


Block diagram of transmitter before and after modification.

socket and the rig turned on. Tune up was then like any other rig. The oscillator slug was tuned to 25.2 mc, the doubler to 50.4 and the same for the final. No parasitics could be found and the circuits would not double tune.

Air trials were most encouraging. Stations worked in York, Pa., approximately 100 miles over the mountains asked if I had increased power! Frequency stability was terrific. I had a station in York zero beat my signal with his BFO. Then I cut my carrier for 60 seconds or so and then turned back on. He said that I was still zero beating with his BFO! All in all, signal reports were somewhat better than before, plus frequency stability and a lack of FM.

For an investment of $4.95 a great deal more pleasure and reliability can be had from your little HW-29. 73



Template for locating two holes to be drilled in front panel of the transceiver.

Build a Transistorized Crystal Frequency Standard

Howard S. Pyle, "YB" W7OE
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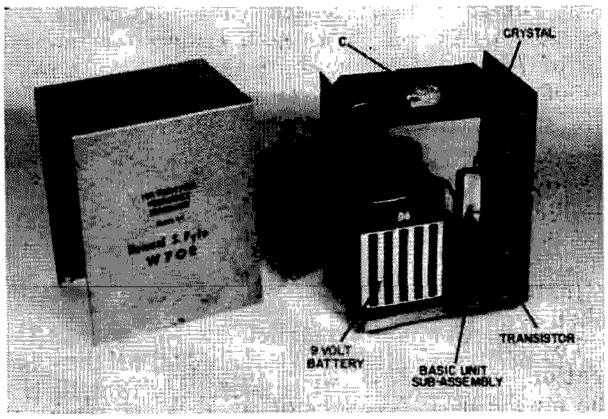
Mercer Island, Washington

FOR some time I had been debating construction of a transistorized crystal frequency standard. A number of crystal authorities whom I consulted warned me that not only would the crystal and the transistor be rather critical but that lead length and routing of the wiring would affect the frequency of even the best crystals. All suggested procuring a basic unit sub-assembly, wired and tested by an established factory specializing in precision crystal/transistor work. I could then build around it with the assurance that performance would equal expectations.

Their arguments seemed logical, although it did begin to look like a rather expensive procedure. At any rate, I commenced shopping around. I didn't want a frequency standard for which I had to use a compensation curve; I wanted 'on-the-nose' accuracy without a lot of namby-pamby, although I had visions of the greatest part of a fifty dollar bill going down the drain! That it *didn't*, continues to amaze me. You know what? I came out with a total cost for the basic unit including transistor, precision ground crystal, cabinet, battery and toggle switch for around *fifteen dollars*, give or take a few cents!

After poring over several excellent 'dope sheets' sent me by various manufacturers, I finally selected the International Crystal Manufacturing Company* Type TRO-1 basic sub-assembly. This was the complete oscillator unit, miniaturized and completely assembled, wired and tested. It measured but 1½" square by 2" high with the crystal in place. The wiring was of the printed circuit type insuring against any change in routing due to vibration or other causes. External wiring required consisted only of the battery leads and the rf output feeder. This little unit was capable of oscillation within the frequency range of 100-300 kilocycles or 200-5000 kilocycles, with the proper crystal! Their TRO-2 sub-assembly will cover 3000-20,000 kc and the TRO-3, 15 to 60 megacycles, in five ranges! Any one of the three basic units will cost exactly *four* dollars; the first surprise! The precision ground crystal is, of course, the greatest cost; $8.50. Several manufacturers offer precision crystals for frequency standard use at from $6.00 to $10.00, but it is recommended that the crystal which the manufacturer has used to calibrate the oscillator be purchased with the basic unit to insure complete accuracy. The same would hold should you elect to purchase a sub-assembly of another make.

*19 North Lee, Oklahoma City, Okla.



This little unit can be mounted right on the chassis of your receiver if you like; practically all modern receivers still have a bit of space available for such a tiny item, in spite of their many components. Or, you can do as I did so that you have a really flexible piece of equipment available for bench testing as well as checking your receiver; mount it in its own separate cabinet.

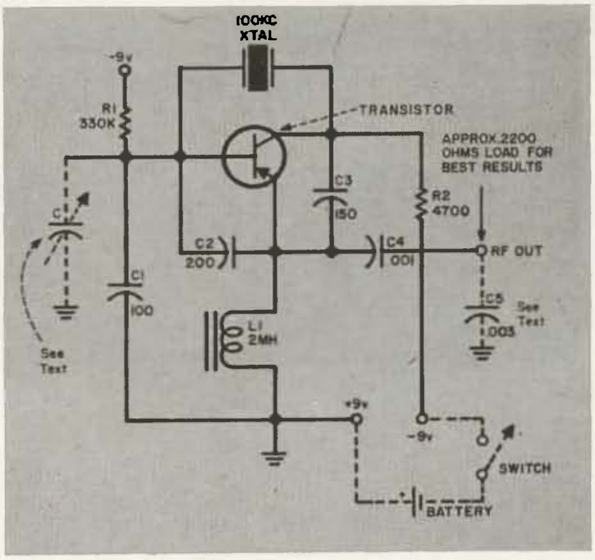
The accompanying photograph illustrates the treatment which I used. As its power requirements are only 9 volts dc at 2 ma, I chose a Burgess type D6 battery and used a conventional, bat-handled toggle switch with which to turn the power on and off. I wired this into the *negative* battery lead; note that the *positive* lead is grounded. Actually, with

this small current drain, such a battery will last for many months *without* turning it off, but for complete flexibility, particularly when installed in your receiver, use a switch.

For the rf output I used a standard phono pick-up jack available at any ham radio store. A short length (6" in my case) of flexible, stranded hook-up wire fitted with an alligator clip at one end and the plug of the phono jack at the other permitted feeding the rf output of the oscillator into my receiver or any other device as required.

The enclosing cabinet which I used was an LMB chassis box which is also a stock item with most ham distributors. The one I chose was LMB's #140 of hammartone grey finish and which readily accommodated all components including the battery. I fitted this with small rubber feet and bent up a small aluminum sub-chassis on which to mount condenser C. This is merely a small trimmer condenser of 7-45 mmfd; the one I used was an Erie, N-500 (most distributors); any equivalent will do. It permits compensating for any minor variation in frequency which may be introduced by the cabinet and the internal wiring therein; though you may not need it, put it in, just in case. A ⅜" hole in the cabinet top, insulated by a rubber grommet, permits adjustment of this condenser externally, if and when required.

To put your frequency standard into operation, set your receiver initially on one of the on-the-nose frequencies of WWV, WWVH or some other known accurate frequency transmission of the fundamental or harmonic frequencies of your standard. Clip the rf output of your frequency standard on your receiver antenna post in place of your regular antenna, and turn the switch on the frequency standard to the 'on' position. If you don't hear the CW tone from the frequency standard, adjust C slightly; it should bring you right on with a minute fraction of a turn. Set for zero beat and you've got it made . . . that's all there is to it!



If you still feel that you'd like to build 'from scratch' without benefit of a basic unit and make your own calibration (it may prove tricky!), the International Crystal Manufacturing Company has been kind enough to give permission to reproduce the circuit which they use on their TRO-1L sub-assembly, together with component values. Like the trimmer condenser C, the fixed condenser C5 is an accessory item, not supplied with the TRO-1L sub-assembly and which you may or may not want to add. It merely serves to improve the wave shape of the output which was of no concern to me, therefore I ignored adding it.

Go to it but remember that just any old crystal, transistor and circuit are liable to cause you headaches! A frequency standard is a precision device; better play it safe!

Polarity Test Paper

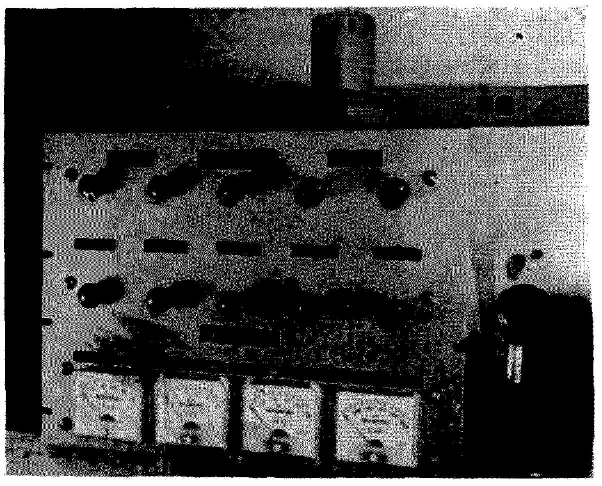
Bob Rooney, W2QCI

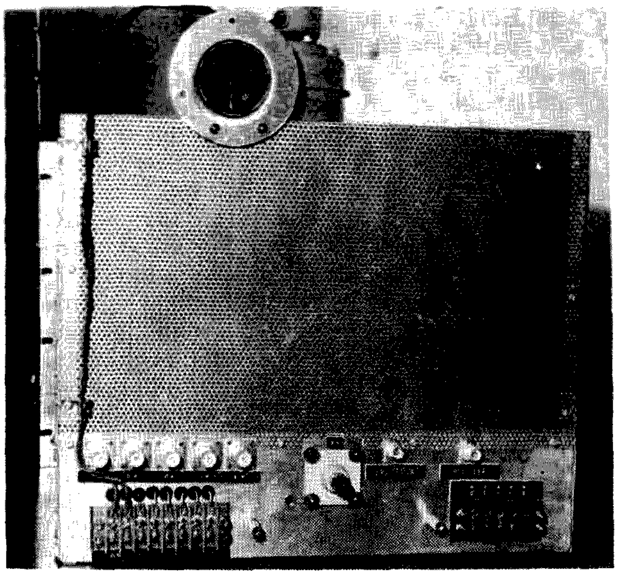
One of the simplest ways to find the polarity of current is through the use of polarity test paper. From two common chemicals which can be obtained at the neighborhood pharmacy, it is possible to make an almost unlimited supply of this paper quickly and economically.

In use, the paper is slightly moistened and placed in contact with the two terminals of the current supply so that the terminals are separated from each other by one or two inches. In the case of direct current a bright red stain will appear on the test paper near the negative terminal. When alternating current is used the red stain will appear at both terminals.

To prepare the test paper we can take any fairly absorbent paper ("Slick" paper such as that which 73 is printed on is not recommended) and briefly soak it in the solution described below. Allow the paper to dry and merely moisten with water before use.

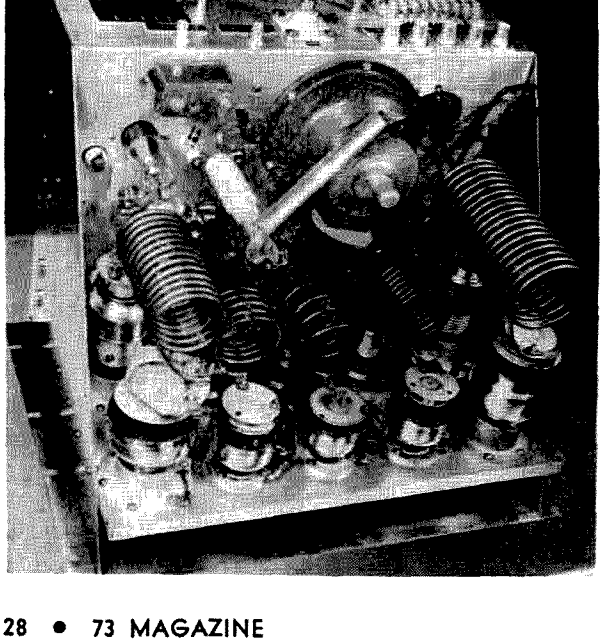
The solution is prepared by mixing one part phenolphthalein solution to three parts of 10% potassium chloride solution.





Suction vs Whooosh

Fig. 1



Paul M. Barton W6JAT
Jennings Radio
P. O. Box 1278
San José 8, Cal.

A SSB Linear Amplifier using a 4CX1000 tube was set up in Jennings type construction, but with provisions for supplying cooling air either from the bottom, or the top of the tube in several ways.

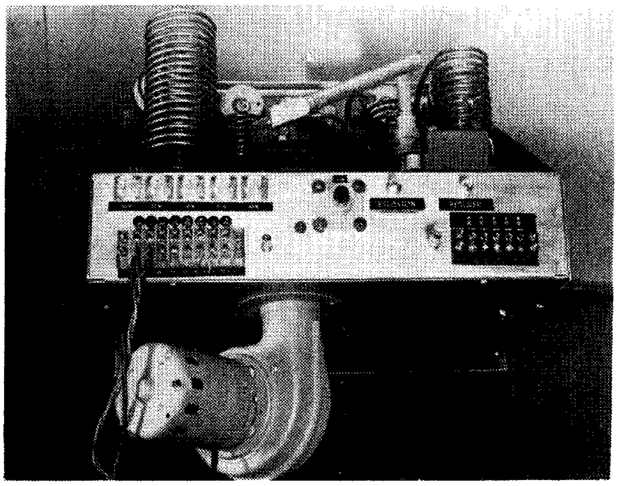
Fixed bias batteries and a variable screen supply were used to set the plate current where desired. 3500 volts of plate voltage was used. As there was no rf power involved, all the dc plate input was being dissipated

by the plate. With different types of blower systems, and for several amounts of dc plate input, the resulting plate temperature was measured with a thermocouple and alternately with temperature indicating waxes.

First, the chassis was pressurized in the more common manner, by blowing directly into the chassis, as in Fig. 2, but with the bottom plate removed, rotated 180° and replaced. This places the blower to one side of the tube socket instead of directly under the tube socket. With 700 watts plate input, the anode temperature came up to 260°F. All tests were run until the resulting temperature stabilized.

It is generally assumed that this simple method of pressurizing the chassis is inefficient due to turbulence, so the blower was plumbed into the bottom of the tube socket with a carefully fitted short direct duct (Fig. 2). The resulting plate temperature was the same, however. The assumption now is that the tube socket itself makes so much air losses that the chassis turbulence is of minor importance (Fig. 1).

Fig. 2



Next, the above two tests were repeated but with two blowers in series, the first blowing into the second, and the second blowing into the chassis or tube base. Now the temperature only came up to 220°F, as one might expect.

Now the plate input was increased slowly until the plate temperature came back up to what it has been with only one blower (260°F). One blower required 700 watts to bring the plate up to 260°F, and two blowers in series required 940 watts for the same temperature. This is an increase of 29%. This *small* increase with two blowers instead of one should be expected as two blowers in series only yield a small increase in air through the tube.

Now a glass chimney was placed over the tube plate fins and a blower was set on top of this chimney so the blower drew its air through the tube, and blew it out into free air (Fig. 3). With 700 watts plate input, the anode came up to 230°F, compared to 260°F with the same blower acting as a blower instead of a sucker.

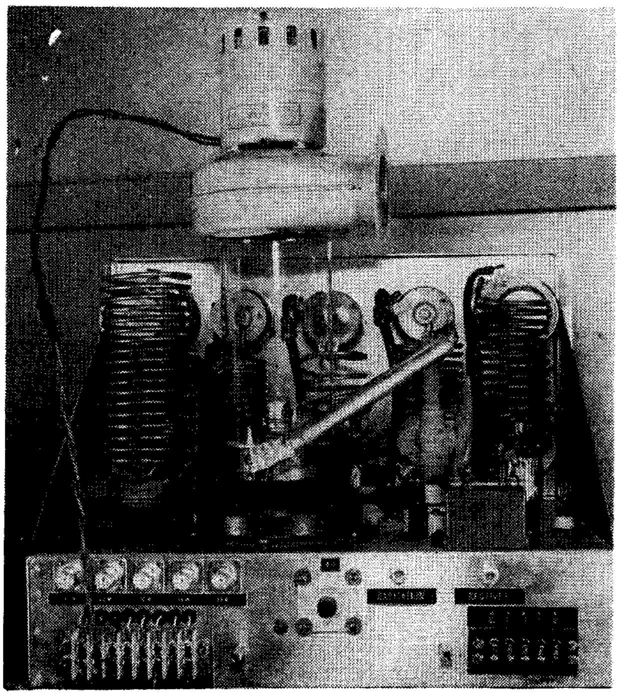
The asumption here is that the sucker arrangement is able to draw more air through the radiators due to less losses in the tube socket, as considerable air will be drawn through the tube radiators that did not have to go through the socket at all (the tube base and filament seal still remained cool enough, however).

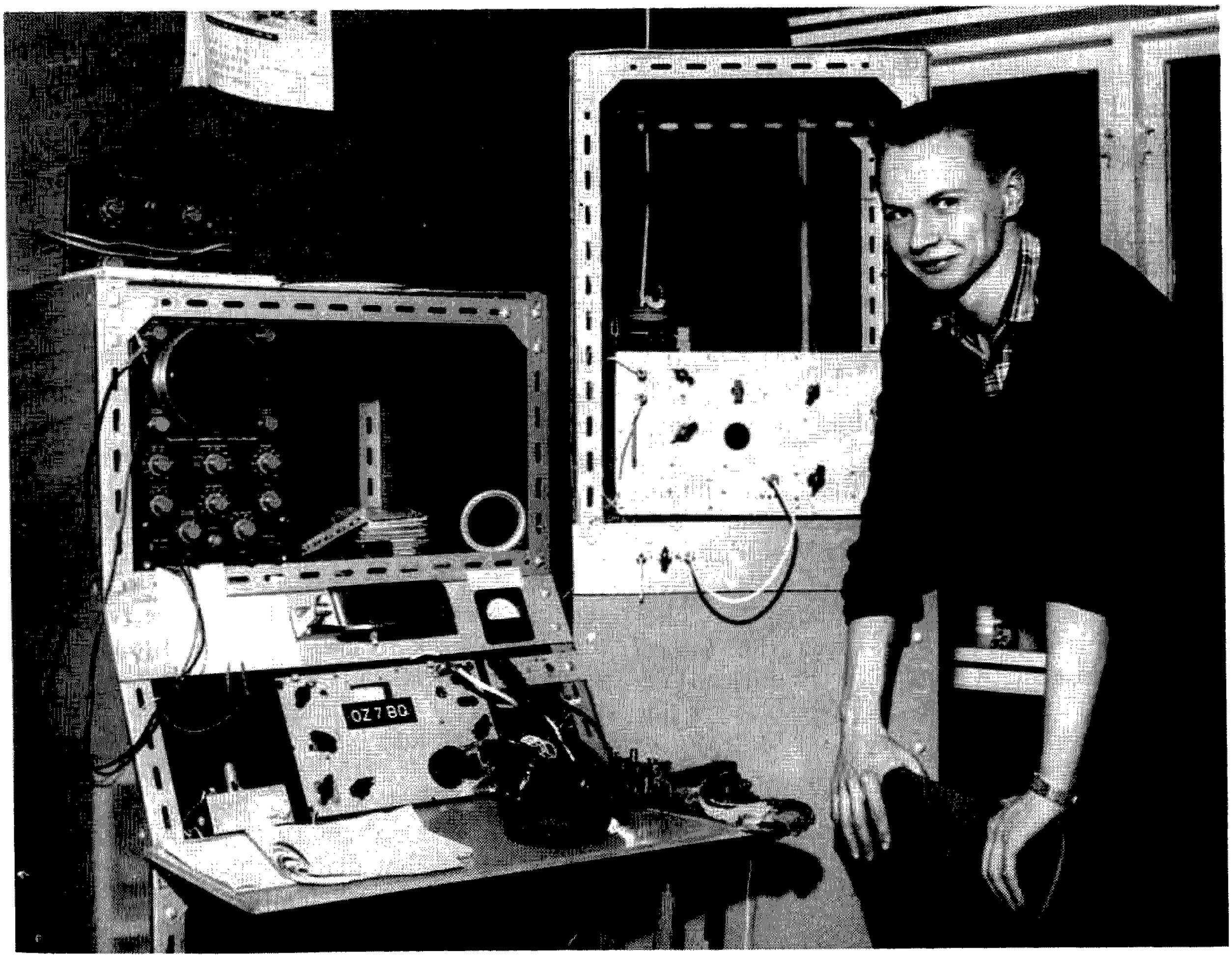
Now the power was increased, using the sucking arrangement, until the plate temperature came back to 260°F. This required 825 watts, an increase of 18% over the blow system.

As an adequate blower for air cooled tubes is quite expensive, this apparent 18% increase in effectiveness, is well worthwhile. It is not held that sucking air through the tubes is more effective, but that it is possible to plumb to the tube more efficiently by sucking.

This system has been used in a number of 1 kw amateur amplifiers with excellent results. The rig pictured belongs to Elvin Feige, W6TT, the well-known dx hound and boating enthusiast. **73**

Fig. 3





Hans Joergen K. Rasmusen, OZ7BQ
31 Borgevej Lyngby
Denmark

AN ALL TRANSISTOR COMMUNICATIONS RECEIVER

ALTHOUGH transistors have been available for several years, they are not as widely used in amateur equipment as one might expect. Amateurs tend to believe they are difficult to work with and troublesome. The transistorized communications receiver to be described should prove that this is not the case.

The receiver uses 14 transistors and covers all bands between 80 and 10 meters. To obtain the best stability, the main receiver covers 3.5 to 4.1 mc. Other frequencies are obtained by using a bandswitched converter. Selectivity is obtained with two sections of a half-lattice filter on 480 kc.

The Converter

The "front end" uses 3 transistors as the rf amplifier, mixer, and crystal oscillator. Although the first *if* is rather high (3.5-4.1 mc), and images are no problem, it is necessary to use high "Q" coils in the rf section to prevent

if and spurious signals from feeding through. The antenna coil is tuned with a 4- 40 mmfd. trimmer. The collector coil is tuned broadly to the center of the band. The crystal oscillator works directly on the crystal frequency and harmonics are used for the injection voltage. On 7 mc there is a problem in choosing the oscillator frequency. To obtain 7 mc, we must add 3.5 and 3.5 mc (crystal oscillator and variable *if*), but since the receiver will tune to 3.5 mc a "birdie" will be heard. Actually the "birdie" will be an eagle, it blocks the receiver 20 kc on either side of 3.5 mc. A practical solution is obtained when the 40 meter crystal oscillator operates on 3.3 mc. The receiver will then tune 6.8 to 7.4 mc.

Since the oscillator operates on the crystal frequency, no coils are required, and output is applied to the mixer through a 10 mmfd. capacitor. Signal mixing takes place in the base circuit of the transistor.

The collector of the mixer is not resonated at the variable *if* but uses an rf choke to obtain a broad bandwidth, and easily covers the 600 kc range.

The Variable IF

The first, or variable, *if* tunes between 3.5 and 4.1 mc, and also uses three transistors. The operation of this circuit is quite similar to the converter but, of course, is tuned to the lower frequency.

Input to the *vif* mixer base arrives from the antenna on 80 meters and from the converter on the other bands. To avoid tracking problems the mixer base and collector tuning capacitor is not ganged to the oscillator. These two adjustments are set near opposite ends of the band for a flat response across the variable *if*.

The variable oscillator is the heart of the receiver for it must be very stable. This is not difficult for the transistors are low voltage and current devices and therefore are not able to heat the adjacent components. The coils and capacitors should be of rugged construction and solidly mounted to the chassis. For the most part stability will be determined by the dc stabilization and, to a certain extent, the room temperature.

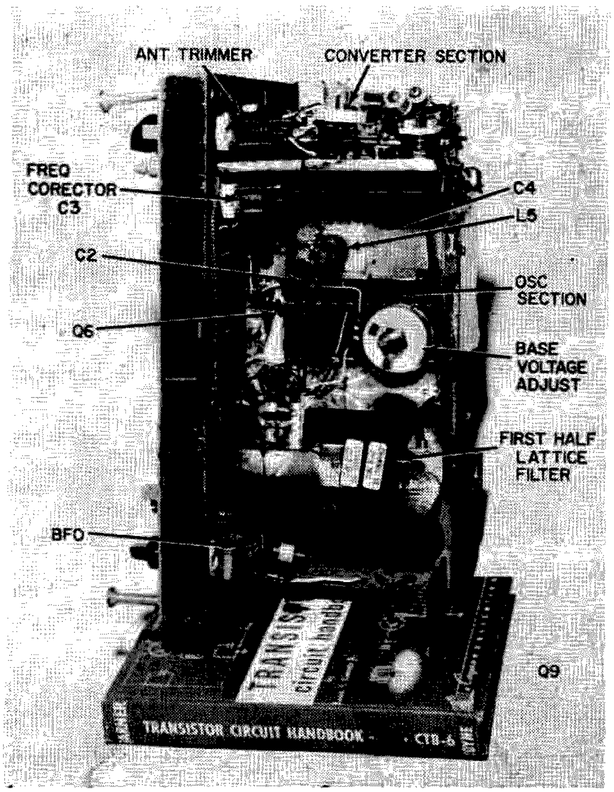
To provide the correct impedance match to the oscillator coil, the collector is tapped ⅓rd from the hot end and the emitter about ⅙th from the cold end. The output is taken from a link wound over the cold end of the coil. One end of the link is soldered to the emitter of the mixer transistor, and the other end is connected to ground. The oscillator and signal frequencies mix to produce a second *if* of 480 kc.

The Second IF Amplifier

In the second *if* selectivity is obtained by means of two section half-lattice filter using FT-241 crystals. The two filter sections must be well shielded to prevent stray coupling between the input and output leads. The filter is followed by two amplifier stages and a diode detector. A beat frequency oscillator is also coupled to the diode, and its frequency is controlled by a variable capacity pitch control. The transformers are standard vacuum tube types to which 50 turn base windings have been added.

The Audio Amplifier

The audio amplifier consists of five transistors, including a class B, push-pull, output stage. Between the first and second amplifier will be found an FL-8A war surplus audio filter to increase CW selectivity. The third transistor is a driver for the output stage. The transformers are standard impedances and American equivalents will make excellent substitutions. The sidetone connection is wired to a neon bulb oscillator and is keyed by the CW transmitter.



The Transistors

The transistors used in the receiver were made by Philips of Holland, but are available in the United States under the name Amperex. If your distributor does not carry them, Radio Corporation of America makes an interchangeable series. The OC170 and OC171 types may be replaced with the RCA 2N384. The OC44 is a junction transistor with a cut-off fre-

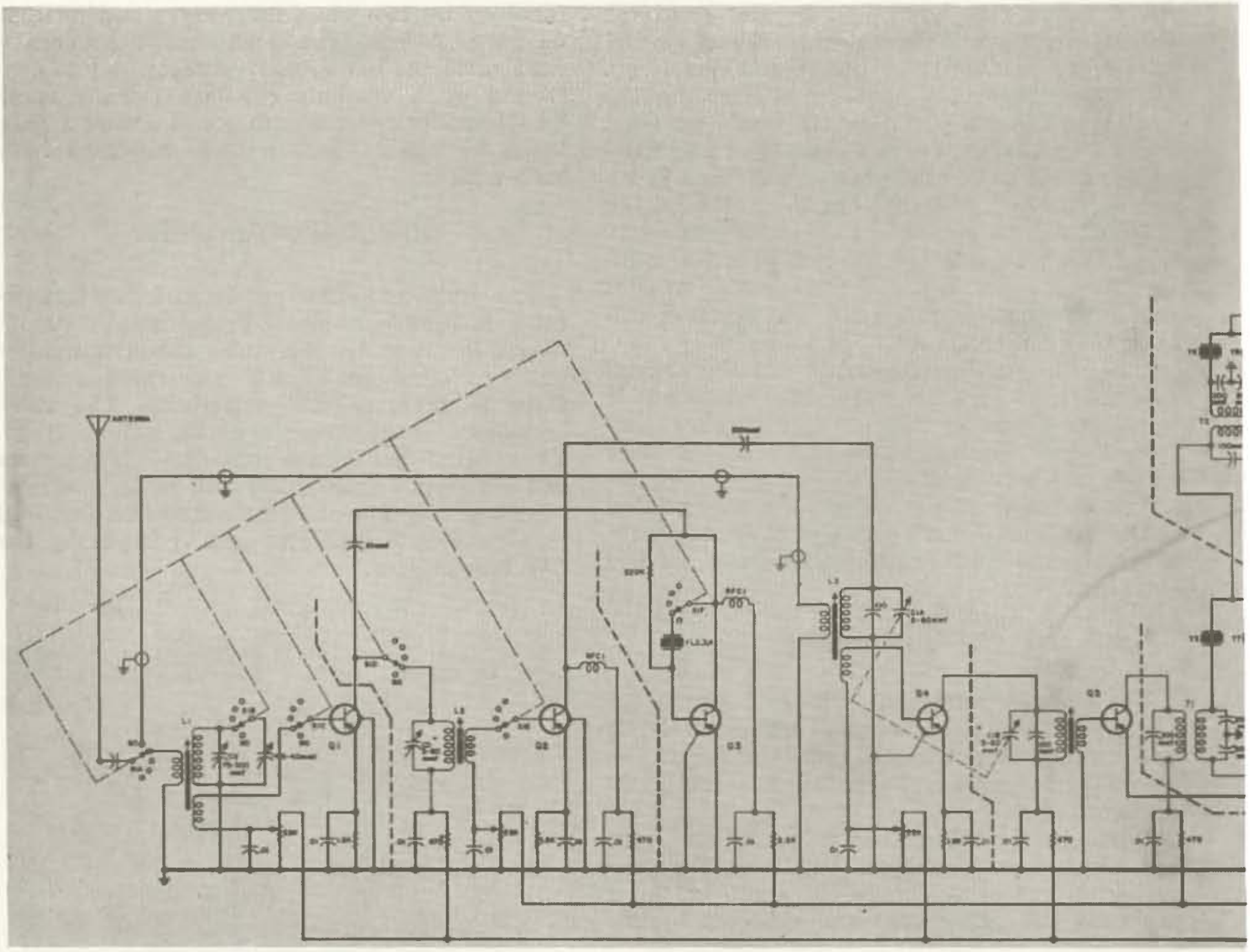
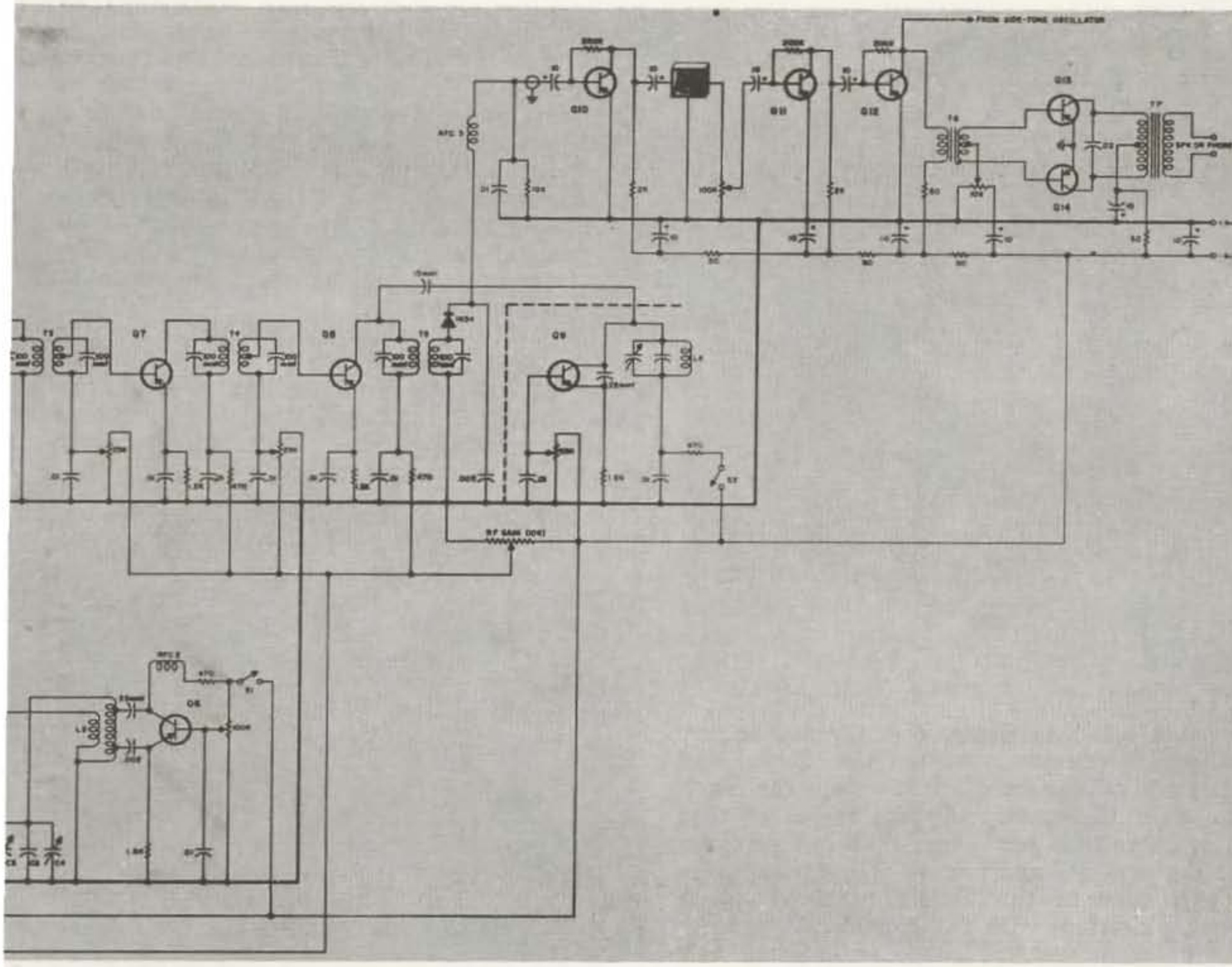


Fig. 1—Schematic diagram for the transistorized receiver. All 0.01 capacitors are

L1—40 meters, 4.05 μh, 15 turns, tap 3 turns up from cold end. Link is 3 turns at cold end.
20 meters, 1.01 μh, 5 turns, tap 1 turn up from cold end, link 1 turn.
15 meters, 0.77 μh, 4 turns, tap 1/2 turn up from cold end, link 1 turn.
10 meters, 0.77μh, same as 15. Spacing—1 turn covers two grooves on 10 and 15 meters.
L2—40 meters, 16.9 μh, 35 turns, link 5 turns.
20 meters, 4.2 μh, 15 turns, link 3 turns.
15 meters, 1.9 μh, 8 turns, link 2 turns.
10 meters, 1.05 μh, 4 turns, link 1 turn.
On 40 wind 2 turns per groove, others 1 turn per groove.
L3—40 turns, 12-65 μh, tap 10 turns up from cold end, link 5 turns.
L4—Same as L3, but no tap.
L5—36 turns, 12 μh, collector tap 12 turns from hot end, emitter tap 6 turns from cold end, link 5 turns at cold end. L3, L4, L5 wound two turns per groove.
C1a, b—Variable if peaking, dual 5-60 mmfd.
C2—100 mmfd on 40, 20, and 15, noneon 10 meters.
C3—50 mmfd on all bands.

quency of approximately 7 mc, and the 2N113, 2N114, or 2N137 should make an excellent substitution. The OC45 is a junction transistor and has a cut-off frequency of 3 mc. The 2N140 will replace this transistor. The OC70 and OC71 may be replaced with any general purpose PNP type. The OC72 is a medium power transistor and has a maximum dissipation of 165 mw at 25°C. The 2N109 can be used in place of this transistor.

To prevent transistors from burning out at high temperatures it is necessary to incorporate dc stabilization. This can be obtained in one of two ways. One method uses a resistor in the collector and one in the base. This circuit is employed in circuits where constant base voltage is not essential, such as the audio amplifiers in this receiver. The best method uses four resistances. One is in the collector, one in the emitter and two (as a voltage divider) in the base. This system provides excellent stabilization and therefore is used in variable oscillators and rf amplifiers, as in this receiver. To make base bias adjustment easier, potenti-



ceramic capacitors. Coil data is given in the accompanying chart (Fig. 2).

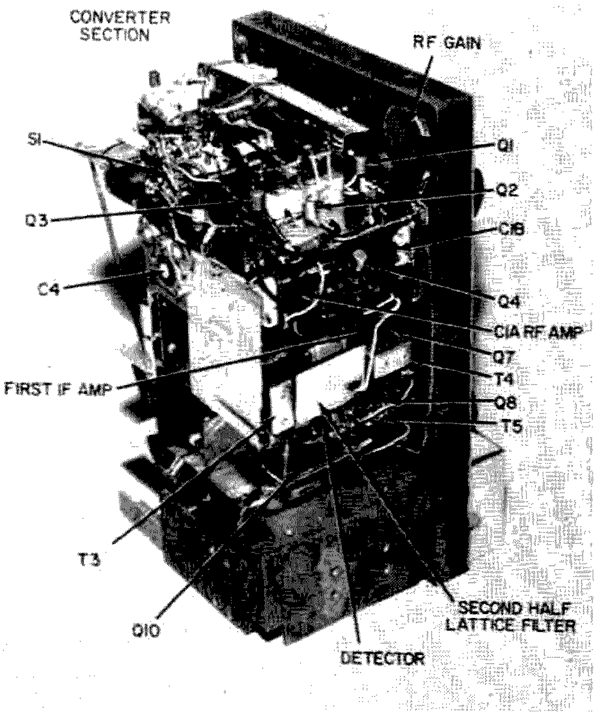
Q1, Q2, Q3, Q4—OC170, 2N384.
Q5, Q6, Q7, Q8—OC44 (see text).
Q9—OC45, 2N140.
Q10, Q11, Q12—OC70, OC71 (see text).
Q13, Q14—OC72, 2N109, 2N217.
RFC1, 2, 3—2.5 mh rf choke.
S1—6 pole, 6 position wafer switch.
T1, T2—Permeability tuned if modified by replacing one capacitor with two series connected capacitors providing the same total capacity.
T3, T4—Permeability tuned if modified by winding 50 turns of fine wire over one winding (base link).
T5—Permeability tuned if (T1-T5 may be modified Miller #913-C1).
T6—10K to 2K ct (Triad TY-56X).
T7—500 ohms to 8 ohms (Triad TY-45X).
Y1—3.3 mc.
Y2—10.5 mc.
Y3—8.75 mc.
Y4—12.25 mc.
Y5, Y6—FT241 surplus, Channel 57.
Y7, Y8—FT241 surplus, Channel 58.

ometers are used as the bias divider.

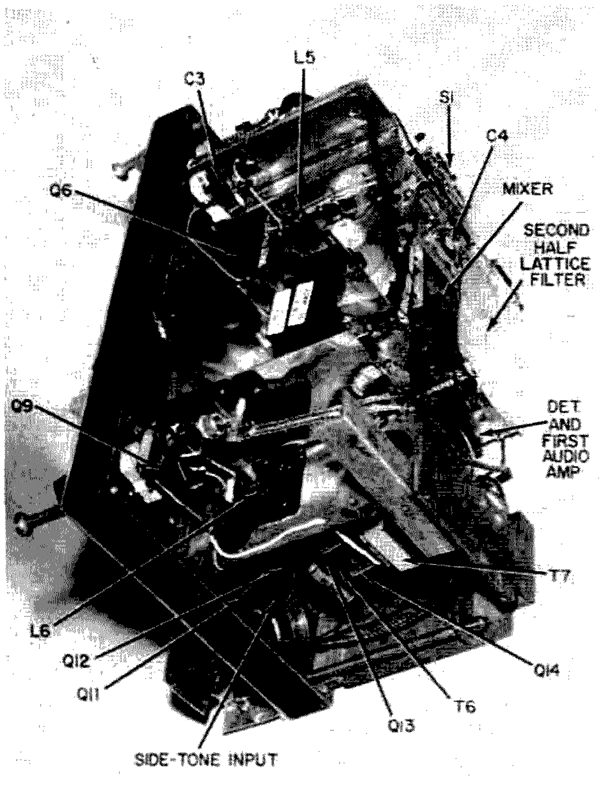
Adjustments

After the wiring has been completed and checked, it is time to adjust the receiver. Measure and set the drain of the transistors, using the potentiometers, at one milliampere. Set the push-pull stage to draw 5 to 7 ma.

Next, remove the transistors from the rf amplifier, mixer, oscillator, and 1st *if* mixer and oscillator sockets. With a grid dip meter, adjust the frequency of each coil to its normal resonant frequency. Insert the variable oscillator transistor in its socket and listen for oscillation on another receiver. The oscillator should tune between 3.01 and 3.61 mc. An oscillation will also be indicated by a change in collector current when you touch the hot end of the coil. If the circuit is working properly, the current will rise. Use the same procedure with the beat oscillator and crystal oscillator. Replace the filter crystals with 10 mmfd. capacitors and connect a signal genera-



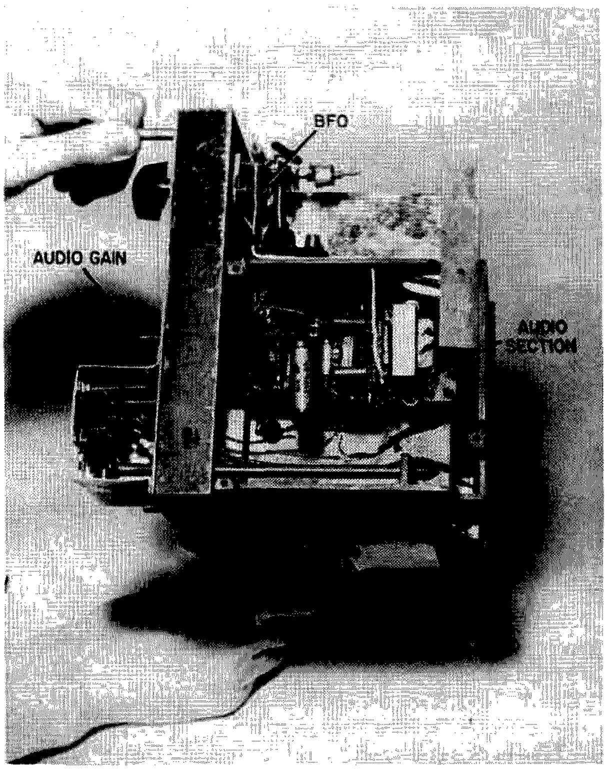
tor (at 480 kc) to the base of the 2nd mixer. Connect a voltmeter across the diode load (10K) and adjust the *if* transformers for maximum gain (keep reducing the signal so that the diode voltage reads less than one volt. Insert the crystals and repeak the transformers on each side of the filter for the strongest signal, consistent with flat response.



Connect an audio signal to the second af stage and adjust the collector current of the push-pull stage for the best waveshape as viewed on an oscilloscope.

Insert the remaining transistors and connect an antenna to the receiver. Set the receiver on 80 meters and connect an rf signal generator which tunes 3.5 to 4.0 mc. Set the generator at 3.5 mc and adjust the coil slugs (L3, L4) for maximum gain with C1a, C1b, near maximum capacity. Next tune the generator to 4.0 mc and retune C1 for maximum gain. The signal strength should be about the same at both ends of the band.

The last step is setting up the converter section. Switch to 40 meters and adjust the 40 meter L1, L2 coils for flat response across the ham portion of the band. Repeat this process on the remaining ham bands. The receiver should now be ready for use.



Transmitting

Since transistors are voltage sensitive, it is necessary to protect the rf amplifier transistor with some form of switch or relay in the line. At OZ7BQ a TR switch of the cathode follower type (connected to voltage divider on transmitter tank) is used. This system gives good protection on a 100 watt transmitter and the final amplifier tank does not function as a trap. The final tube(s) must be run cut-off in receiving periods so that noise is not generated. Several methods of receiver blocking have been tried. The smoothest break-in was obtained when the variable oscillator was keyed off with a positive base bias.

Layout

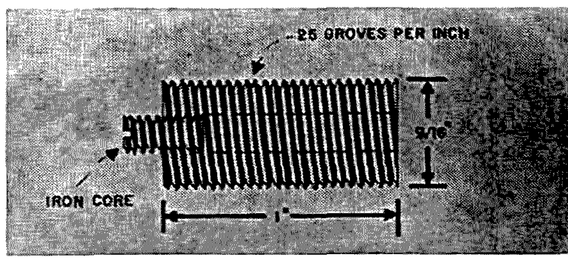
The chassis layout is somewhat unconventional. Each stage is mounted in a small box. This provides excellent shielding and permits each stage to be removed for circuit changes. The boxes are made of tinned metal from coffee cans. The boxes are soldered in such a manner that you can reach the parts when they are mounted on the front panel. For rigid construction, these boxes are mounted to the front panel with several screws. The oscillator variable capacitor is mounted directly on the front panel. Even when the receiver is given quite a blow it shows no signs of frequency instability. Layout of the components is not critical if the rules of tube construction technique are followed. Photos of the receiver, which measures 7" x 8" x 12", show the assembly and layout.

Conclusions

Many things have been learned by constructing and operating the transistorized communications receiver. The oscillator drift is less than 1 kc in warmup. The sensitivity has been compared with modern American receivers and is equal to them on all bands. The maximum volume, of course, is somewhat lower, and reception is best with headphones. The power could be increased from 200 mw to more than one-half watt by using a 12 volt supply on the class B stage.

With no signal the current drain is 15 to 20 ma, and it kicks up to 140 ma on audio peaks. The use of a 6 volt supply permits the receiver to be used at home, in an automobile (new or old), or portable with the same excellent results. **73**

Fig. 2—The coils with the "L" prefix are wound on this type of form. Any slug tuned form of this approximate diameter and length should be satisfactory, atlhough the grooves make winding easier. Number 26 enam. is used for all coils.



New Products

Two Meter Transmitter-Receiver

The Heath "Pawnee" is a complete two meter transmitter with VFO or crystal control and 10 watts rf output to the antenna through a low pass filter to eliminate TVI. The receiver is double conversion and of high stability. A three-way power supply is built in: 117 vac, 6 or 12 vdc. Comes complete with built in speaker, mounting bracket and ceramic mike. Measures 6" x 12" wide x 10" deep, 34 lbs. Price in kit form: $199.95 from the factory. There are a lot more juicy details you'll want to know about on this so drop Heath a line at Benton Harbor, Michigan so they can fill you in.

Grounded Grid Kilowatt

Heath is at it again. Here is a neat little linear running four 811A's for 1000 watts PEP, 1000 watts CW or 400 watts AM phone. It requires 50-75 watts drive and may be driven by any exciter of up to 125 watts without any swamping network being needed. Built in power supply. TVI suppressed and all that. 80-40-20-15-10 meters. 90 lbs. $229.95. You do want to know more about this beau . . . holy smokes! Did you see that price? Unbelievable. Quick, before they discover their mistake, write for info. Heath Benton Harbor, Michigan. And if you forget to mention 73 when you write please cancel your subscription

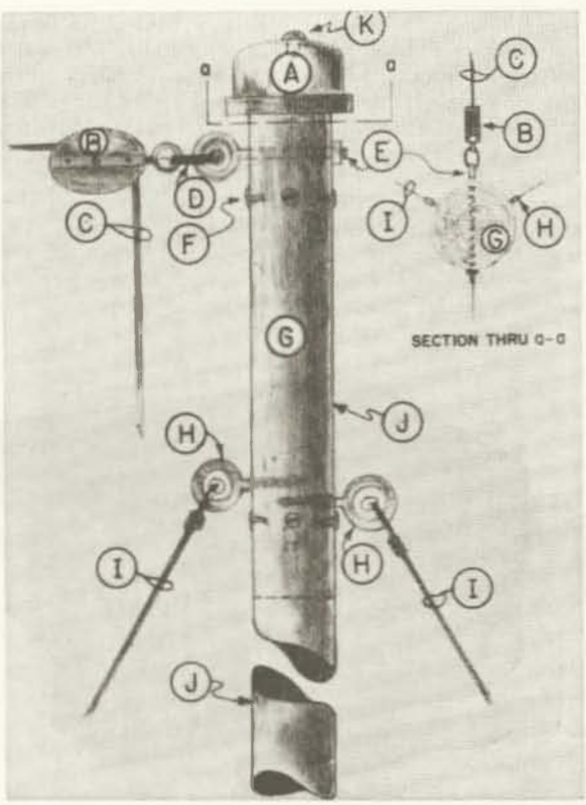
A Novel, Light-Weight, Low-Cost

ANTENNA SUPPORT MAST

and Vertical Radiator

This unique design results in a sturdy, easily handled and effective support for a horizontal wire antenna as well as 'doubling' as a vertical radiator. Weight is less than 35 pounds and the cost is under $15.00!

Howard S. Pyle W7OE
3434—74th Ave., S.E.,
Mercer Island, Wash.



MORE substantial and less costly construction of both vertical and horizontal wire antennas should prove a welcome addition to amateur radio design practice. Presented here is an innovation in the way of a combination antenna support mast for wire antennas which can serve as well as a vertical radiator for those who desire to experiment with both antenna types. Better still, it is so light in weight that it can easily be erected by two men, one holding down the base while the other 'walks it up'. If more help is available, put a man on each of two of the center guy wires for added insurance against bowing and swaying during erection.

Parts List

A—2" galvanized iron pipe cap
B—Pulley block of your choice
C—Down-haul rope or cable—about 35 feet required
D—Shackle or auto tire chain repair link
E—Galvanized eye-bolt, ¼" x 3" with nut (insulated eye type)
F—#8 x ⅜" galvanized sheet metal screws (42 required)
G—Wood re-inforcing plug, 2" diameter by 18" long (4 required)
H—Porcelain insulated screw eyes—(6 required)
I—#14 solid galvanized iron wire
J—2" diameter galvanized iron rain pipe (4 ten foot lengths required)
K—2" #12 brass or galvanized iron round-head wood screw

(Unless otherwise specified, only 1 each of above items required.)

While some difference of opinion exists among various authorities as to the proper height of a vertical radiator for amateur usage, popular pratice seems to favor 33 feet, plus or minus a foot or so, depending upon the desired resonant frequency of operation, calculated from existing formulas. Such a height is the equivalent of a quarter wave-length in the 40 meter band, a half-wave on 20 and full wave on 10 and works well on all. On 15 meters, the efficiency is but slightly impaired and is really a matter of no concern. In the 75/80 meter band, functioning as a vertical radiator, the mast is somewhat less effective than at higher frequencies, but as the 75/80 meter band is not considered a 'DX' band, the excellent ground wave propagation of a vertical of this height assures reliable communication over several hundred and often a thousand or more miles, dependent upon transmitter power. We have therefore settled on the mechanically practical height of between 32 and 34 feet which, in addition to being very effective as a vertical radiator, also permits a horizontal wire antenna to be installed at a satisfactory height above ground level, if desired.

The mechanical structure itself is somewhat unique in that instead of using a wooden mast or pole, with copper tubing down the side and topped with a 'whip' antenna, or using water pipe, electrical conduit or irrigation piping, *rain-pipe* of the 2" galvanized, round type is used. This is available from hardware stores, builders supply houses and plumbing dealers practically anywhere and at nominal cost. In the writer's area, it is priced at 15c per foot and comes in ten foot standard lengths. This means that you will need four of the ten foot sections and must necessarily discard a portion of one if your mast will 'double' as a vertical radiator and is cut to resonance. The few feet you discard however, represent a very small loss which can be disregarded in view of the low over-all cost of the complete mast.

Mast Assembly

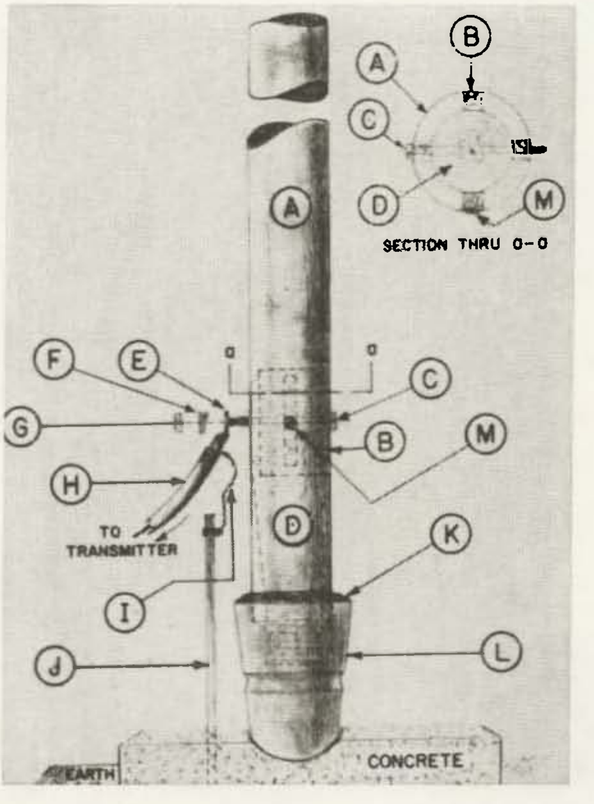
As supplied, pipe sections are fluted at one end for a few inches to permit telescoping. Cut off the fluted end with a hack-saw or tin snips. Procure from your local lumber yard, a six foot length of what is known as "full-round" wooden stock in the 2" size. Cut it into four 18" lengths. These will serve as 'plugs' or connectors between sections and are shown at "G" in Fig. 1, and as "A" in Fig. 3. Use these to connect the sections, driving about half of their length into each end of the rain pipe and securing them with sheet metal screws as shown in the drawings. Butt the ends of the metal pipe closely together and run a generous solder bead completely around the metal joint for electrical contact between mast sections. Do not depend on this however; mechancially, the wooden insert will be adequate. Electrically, a litle wind sway in the mast could conceivably break the solder seal and destroy the electrical conductivity. So, make sure of this by strapping the sections together with galvanized plumbers tape or ground straps of copper at all three points (120 degrees apart) as shown at "D" in Fig. 3. This 'tape' or strap metal is generally sold in ten foot coils and one roll of ten feet will be sufficient for all joints. Use sheet metal screws as in Fig. 3 to hold it in place and then make it a *good* electrical joint by flowing a solder bead around it as in "E" of Fig. 3. Not only will these straps insure good electrical conductivity for your rf, but the mechanical strength of the joint will be greatly enhanced as well.

Your next step will be to saw, or cut with tin snips, the excess length of the initial 40 feet of mast assembly. Determine the length of the mast from handbook formulas and cut the *top* section to bring the over-all length into

Parts List

- A—2" diameter galvanized iron rain pipe (4 ten foot lengths required)
- B—Balsa wood spacer strips (see text)
- C—10-24 Galvanized or brass stove bolt, 3" long
- D—Wooden cross-arm insulator pin (see text)
- E—Solder lug to fit "C" and "H"
- F—Galvanized split lock washer to fit "C"
- G—Galvanized or brass 10-24 nut
- H—Co-axial cable (RG8/U or RG58/U) (length as required)
- I—Braid from co-axial cable to ground clamp on "J"
- J—Five or six foot copper-clad steel ground rod
- K—Mastic or roofing pitch waterproofing (see text)
- L—Petticoat type of pole line insulator (see text)
- M—¾" x #10 pan-headed sheet metal screws (2 required)

(Where no quantities specified, one only of item listed, required.)

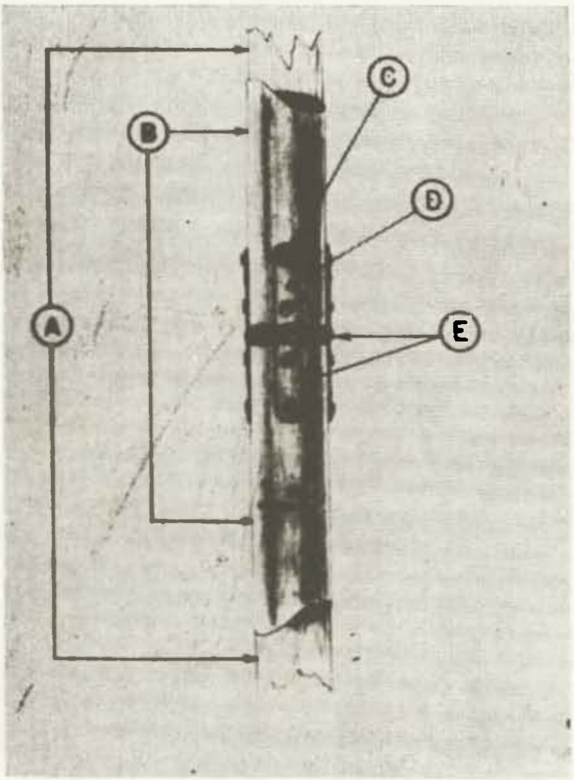


conformity with your calculations. Remember to measure from the point of feeder connection at the base ("C" in Fig. 2) to what will be the top of the mast.

Insert the final plug into the top of the mast and drive it flush, securing with sheet metal screws as shown at "F" in Fig. 1. To prevent rain drip from going down the interior of the mast and rotting the wooden plugs cap the top either with a 2" galvanized pipe cap ("A" in Fig. 1) or a coffee can lid and a wooden, rubber or plastic ball, if you want to be really decorative. Toilet tank float balls, either plastic or metal will serve well here if you don't care for the flat treatment of a pipe cap.

Mast Hardware

Your assembly of the mast itself is now complete. We assume that you have, of course, paid proper attention to supporting it on saw horses or boxes so that it assumes a perfectly level formation which will insure a plumb and pleasing appearance when erected. A sixteen or twenty foot length of ¼" x 1⅝" lattice (real cheap at lumber yards) makes a good straight edge, when used edgewise, to check this. Your next step is installation of a few hardware items on the mast. First, let's mount the guy wire anchors. If this were to serve *only* as a supporting mast for a horizontal wire antenna we could get by here with conventional galvanized iron screw eyes or eye-bolts. However, as we might want to use this also as a vertical radiator, either initially, or later, why not make provision for such use now? So, let's use the *insulated* type of screw eye, commonly available in all TV and radio stores for a few cents. By so doing you don't have small radials and poor rf contacts to upset your theoretical calculations for antenna height vs. frequency. And you'll find it a big help in avoiding TVI which could result from microphonic contact between guy wires and mast!



OK; mount three of these insulated screw-eyes about 16" down from the top of your mast, spaced 120 degrees around the circumference. They will serve as anchors for your upper series of guy wires (see "H" in Fig. 1). Do the same at either the ten or twenty foot level of the mast; they will anchor your second set of guys. I prefer the twenty foot level but do as you see fit. You can even drive an additional wooden plug half-way into the second (from bottom) section of the mast if you want the lower guys at a point about half-way up; the decision is yours. Remember to 'stagger' the screw-eyes at least half an inch in the vertical plane or their shanks will collide!

And now, the final hardware mount; the eye-bolt at the top of the mast (a few inches below) which will receive the pulley block for the down-haul for the wire antenna. This eye-bolt should also be insulated and can be a galvanized type, three inches long, going clear through the mast and wooden plug as shown in Fig. 1 at "E". The pulley block itself can be anything you choose; galvanized iron, bronze, wood block with metal sheave, etc. Connect the eye of it to the eye-bolt in the mast with a conventional 'shackle' (hardware stores or marine supply houses) or, if no local source for shackles, use an automobile tire chain repair link, available at any automotive service station, tire shop or auto supply store.

Now, if you have your guy wires in place and your down-haul riven through the pulley sheave, you need only cut the guy wires every fifteen feet and insert a suitable insulator. This should preferably be of the compression type as, in the event of breakage, the guy does not let go. The small, glazed porcelain type known as 'airplane' strain insulators, are ideal; these sell for less than 10c each at most radio stores. With their installation, work on the mast itself is now complete, mechanically. We recommend that you now give it at least two thorough coats of a lead base paint in any color that suits your fancy. Not only will this act as a preservative against rust, but will considerably improve the appearance of your final mast.

Parts List

A—2"x18" length of 'full-round' wooden pole (4 required)
B—2" diameter galvanized iron rain-pipe (4 ten foot lengths required)
C—½" x #8 pan-head galvanized sheet metal screws (12 at each joint)
D—Perforated steel strap—about ten feet required (see text)
E—Solder application (see text)

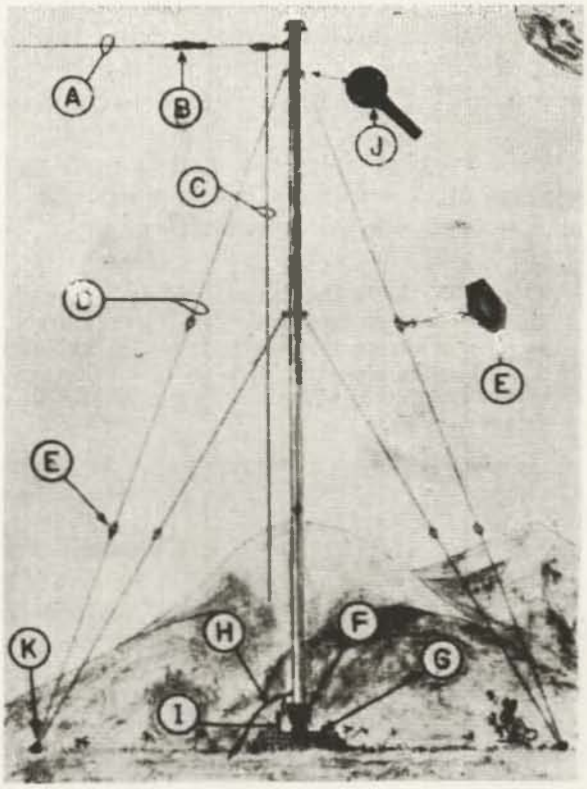
Mast Base Mounting

While the paint on the mast is drying (two coats take several days you know) it's a good time to prepare the base mounting. This isn't too bad and involves only digging a hole in the ground about a foot square and approximately ten inches deep. Make a little form of scrap lumber if you're meticulous, let it protrude about two inches above the ground level. Fill the thing with concrete; you can get "ready-mix" sand, gravel and cement in a convenient bag at your lumber yard). Follow the consistency instructions on the sack and you'll come out all right. After it sets up about half hard, bevel the top four edges if you like for a more professional job. At the same time, scoop a circular depression in the center of the top of the concrete base to act as a 'socket' for the base insulator to be next described. Use a trowel for this operation or you can use the insulator itself in 'pestal' fashion to achieve this. Now you can leave the base alone while it sets up (about 24 hours). The base insulator should next be procured and mounted on the mast. See the 'outside line construction foreman' of your local power or telephone company and show him Fig. 2. He will immediately recognize "L" and "D" as a standard cross-arm insulator ("L") and wooden mounting pin ("D"). Wheedle, cajole or buy such a combination from him . . . it will cost you little. The insulator "L" can be either glazed porcelain or of blue/green bottle glass as used by the phone companies. Either is more than adequate electrically and mechanically.

The end of the wooden pin opposite the threads will be too small for your 2" mast. Build it up to the 2" diameter required with short wood strips (4), nailed with small brads to the pin itself. Balsa wood, usually available at most lumber yards, variety stores and hobby shops, will work well here. Get something about half an inch wide and of a suitable thickness to fill the gap when installed as shown in Fig. 2 at "B". A foot of this stock will be adequate. Mount the insulator and it's pin as in Fig. 3 and you've got a complete antenna mast and vertical antenna ready for erection when the paint dries!

Again you don't have much of a problem in tying your guy wires into the ground. You'll need first three spots 120 degrees apart (approximately) and at a minimum of 7½ feet from the center of the mast base. 10 feet is better, but 7½ will do very well. With a piece of string, centered on the mast base, you can scribe a circle on the ground and determine your anchor points. Maybe you have a convenient tree, a stump or a building which will serve, in the approximate area. If so, use it. If not, you have several choices for guy anchors. You can *buy* conventional, drive-in or screw-in types of pole line anchors from your power company; they won't be cheap however. You can dig a hole about two feet deep and three feet square, make a cross of a couple of 30" 2" x 4" timbers and lay them in after wrapping some stub lengths of guy wire around them to which you can tie your guy wires above ground. Or, you can dig holes about a foot square and 18" deep, set a six or 8 inch eyebolt (galvanized of course) in the approximate center, pour the hole full of concrete mix and wait for it to set. Any of these methods are good; you choose the one which you like best. Even six foot lengths of 1" pipe, driven at about a 30 degree angle, will do the trick.

And, with all of the above done, you need merely raise your mast, tie on the feed-line as shown in Fig. 2, or raise your wire antenna in place, or both, and you're "on the air" with either a wire antenna or a vertical or both at will, as you choose! Lay back now and take it easy; *this* is a mast which will last you a l-o-n-g l-o-n-g time! 73



Your Completed Antenna Support Mast/Vertical Radiator Should Look Like This!

A—Horizontal wire antenna
B—Insulator for "A"
C—Down-haul rope or cable (use a sash weight at lower end or anchor to a cleat or eye-bolt near base of mast)
D—Guy wire (#14 galvanized iron)
E—Airplane type of "goose-egg" strain insulator
F—Glazed porcelain or 'bottle-glass' petticoat pole-line cross-arm insulator
G—Concrete base; about 1 cubic foot
H—Co-axial cable feeder (RG8/U or RG58/U)
I—Ground rod (5 or 6 foot, copper clad steel with clamp)
J—Porcelain insulated screw-eye insulator
K—Guy wire anchor

The Diligent Detector

73 Staff

So far as most of us are concerned, the detector is the "forgotten man" in a communications receiver. Ultra-simple circuitry, tried and true over the years, tends to make us think of the detector (when we bother to think about it at all) as one of the most nearly perfected parts of the set.

The general impression that detectors have little room for improvement isn't correct. For a few cents worth of parts and a few minutes time, you can reduce your set's detector distortion to a fraction of its previous value. This will do a near-miraculous job of cleaning up formerly-muddy signals whose only actual fault was 100 percent modulation, and may even restore broken friendships if bad signal reports caused the breach!

You can take your choice of a number of circuits to accomplish this end, thanks to the audio fraternity which devotes much of its time to reduction of distortion. Some are nearly as simple as the conventional detector, while others involve addition of one or more tubes to the set.

Each of these circuits has its own set of advantages and disadvantages, making the choice a bit more complicated than one of mere time and complexity. The purpose of this article is to list these circuits, together with their pros and cons, to make it easy for you to pick the one best suited to your own needs.

Before going into the newer and more-sophisticated detector circuits, a brief review of the conventional detector is in order. To clarify the approach used in this review, you know that an ordinary AM signal may be visualized in either of two ways: It may be considered to be a single, steady carrier wave varying in amplitude, or it may be thought of as an unvarying carrier accompanied by sidebands of varying strength which are later mixed with the carrier to produce sound.

While the second visualization is more correct in the mathematical and physical sense, there is no measurable difference between the two. To avoid complicating this article with exotic mathematics, the first (and older) visualization has been used in explaining diode-detector action.

Since the most common detector in use today is the diode, let's look at it first. Most diode detector circuits are similar to that shown in Fig. 1. You may find a crystal diode instead of the tube in some receivers, but the principles of operation remain unchanged.

Similarity between this circuit and an ordinary half-wave power supply (less filter) is evident. However, the two circuits differ drastically in several important operational details.

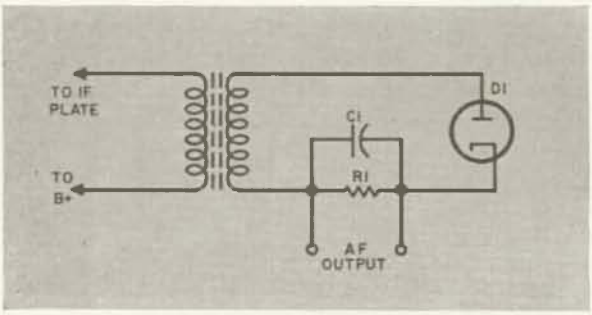
In a power supply, the design factors are chosen so that current will flow over as much of the cycle as possible without flowing during the reverse half-cycle. This reduces ripple voltage in the output to a minimum.

In the detector, however, the objective is to make current flow through the diode in a series of extremely short pulses. This is accomplished by making the resistance of R1 very large compared to the diode's forward resistance, and by making the applied signal voltage as large as possible without running into overload.

Under these conditions, C1 is charged by the short pulses, and if the time constant is properly chosen the capacitor voltage will rise almost to the peak value of the applied signal. The voltage will vary in a linear manner with the strength of the applied signal as measured at the peak. For this reason the circuit is known to engineers as a "peak-linear" detector.

Note that the voltage impressed on C1 will follow the signal modulation envelope only if the tube voltage drop is negligible compared to applied voltage. At low signal levels, every rectifier becomes a "square-law" device whose

Fig. 1. This basic circuit, or slight variations of it, is the second-detector in use in nearly every radio receiver on the market today. Except for the filter, the circuit is identical to a half-wave power supply but operates in a completely different fashion.



voltage output varies with the square of input voltage rather than varying linearly. Square-law detectors produce excessive distortion of AM signals, but are useful as mixers.

Under normal conditions, the output of an ordinary diode detector contains about 5 percent harmonic distortion. While signals are perfectly readable with this amount of distortion, reception can become extremely tiring to the ears—as anyone who has ever operated in a contest knows.

In addition to introducing distortion, the peak-linear detector plays another sneaky trick on the signal—it cuts down the effective modulation percentage.

This can happen because the *if* amplifier feeding the detector has very poor voltage regulation. Output of the *if* transformer, with the same signal applied to the amplifier, is considerably less under load than it is with no load—and the diode detector represents a very appreciable load.

What's more, this load varies with strength of the applied signal since the diode's impedance will vary with voltage applied. This means that the *if* amplifier is under a heavier load for the sidebands of a signal than it is for the carrier, and the ratio of sideband power to carrier power as measured at the detector is reduced.

Bad as this sounds, it's actually no loss—since a peak-linear detector is not capable of reproducing a 100 percent modulated signal without severe distortion. In one typical case, breakup of the signal became objectionable at 75 percent modulation. Other authorities claim the effect is severe at 70 percent. By reducing effective modulation percentage, the diode makes itself able to handle a more-deeply-modulated signal than could otherwise be accommodated.

Distortion in a peak-linear detector is caused by three major factors. One—curvature of diode characteristics—is outside the control of the designer or the set owner. The other two can be controlled to some degree, but the control always represents a compromise.

Whenever the dc component of the signal and the ac component meet different load lines, distortion is sure to result. This situation occurs if AVC is derived from the detector, if an S-meter is connected to the detector circuit, if an automatic noise limiter is incorporated, or if the detector feeds an audio amplifier. The last condition is necessary if you're going to hear anything out of the set!

This condition, known variously to engineers as "clipping" and as "differential distortion," is the major factor limiting acceptable modulation percentage. Distortion in conventional circuits remains under 5 percent at moderate modulation levels, but rises rapidly to 12 to 20 percent when modulation depth approaches 100 percent.

The third factor introducing distortion is the RC time constant of the detector load (R1 and C1 in Fig. 1). If the time constant is too long, "bottoming" will occur on negative half-cycles of the incoming signal, producing a raspy and most objectionable sound. If it is too short, detector output will be low and rf ripple will be too high. This is not usually a problem, since design values found in most sets represent a highly acceptable compromise between output level and distortion.

With this background established, we're ready to examine some low-distortion circuits and to compare them to existing detectors in your receiver.

One of the simplest of the low-distortion circuits is the "diode integrator" described a couple of years ago by Leonard Geisler. It's shown in Fig. 2.

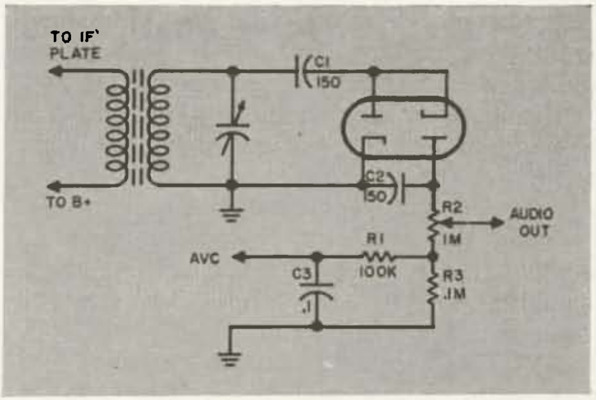


Fig. 2. The diode integrator, sometimes called a peak-to-peak detector, provides a virtually open-circuit load to the *if* transformer secondary. All distortion resulting from assymetrical transformer loading is thereby eliminated, and detector efficiency is increased.

Instead of being patterned after a half-wave rectifier, this circuit is an adaptation of the full-wave voltage doubler. Since it is a full-wave device, it utilizes both halves of the input-signal cycle rather than only one, with resulting increase in efficiency.

The reduction in distortion is brought about by the fact that one of the two diodes is conducting at all times, and both diodes never conduct simultaneously. With both CI and C2 set at the same value, the *if* transformer always sees a capacitive load—and under this

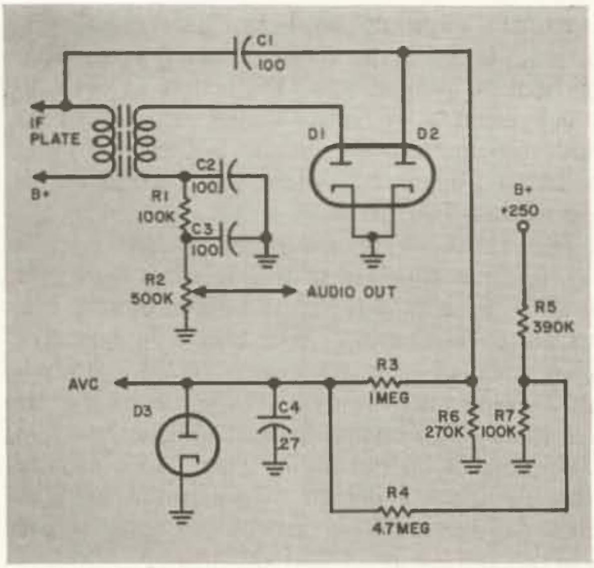


Fig. 3. Most complex of the detector circuits shown here is the "sinking diode" arrangement which includes delayed AVC and reduces distortion. Crystal diodes can be substituted for D1 and D2, but D3 must be a tube to achieve extremely high reverse resistance.

condition, the capacitance can be trimmed out by returning the *if* transformer to resonance. This results in an effective load of nothing at all; at one fell swoop you have eliminated modulation cutting and have more than doubled the efficiency of the detector.

Advantages of this circuit are the reduction of distortion and the removal of loading from the output *if* transformer.

Its major disadvantage is the high output produced; in new-design equipment this is no handicap, but when you modify existing equipment the 35-volt peak-to-peak audio which comes out of the integrator and the 100 volts of AVC both prove somewhat unhandy to work with. While voltage dividers can be used to trim them back to more conventional values, the dividers will then introduce frequency distortion and differential loading effects which may cancel out the advantages of the circuit.

Another low-distortion circuit is the "sinking diode" arrangement described by Langford-Smith and shown in Fig. 3. This circuit eliminates differential distortion and also produces delayed AVC, at the cost of several additional components. It has been applied in at least one receiver-updating technique, and excellent results have been reported.

This circuit is identical to the peak-linear circuit insofar as the detector itself is concerned. The only departure from conventional techniques is use of a voltage divider and a clamping diode (D3) to first apply a positive bias to the AVC line and then to clamp the line to ground.

The result is that the AVC line must overcome the positive bias to become effective, but can never go positive itself. The voltage-divider circuitry provides a constant load for the AVC diode, preventing interaction with the detector diode coupled to the same transformer and thus eliminating differential distortion due to the AVC action.

The advantage of the circuit is its reduction of distortion, coupled with DAVC provision.

Major disadvantage is the requirement for added components. A secondary disadvantage is the requirement for "cut-and-try" tailoring of component values in the AVC circuitry.

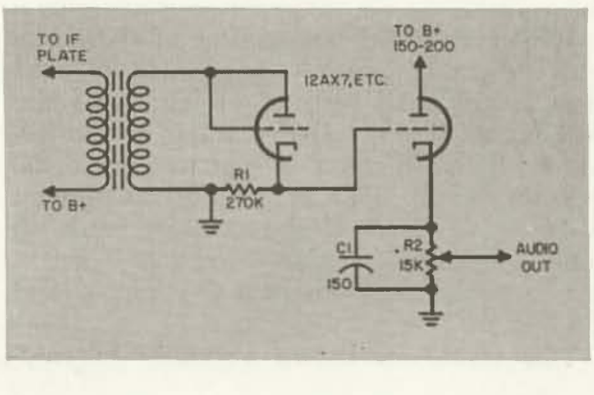
Since much of the distortion in a peak-linear detector is caused by interaction with associated circuits, use of some sort of isolation device appears to be a natural to eliminate the distortion. One of the simplest and most popular such devices is the cathode follower.

Two circuits combining the diode detector and the cathode follower have been published, and excellent results are reported with each.

The simpler of the two was developed by W. T. Selsted and B. H. Smith in the Radiation Laboratory of the University of California, and appears in Langford-Smith's writings. In it, the cathode follower follows the detector (see Fig. 4) but precedes the load capacitor and filter components.

Claimed distortion reduction is from 12 percent to less than 1 percent at total modulation. This is achieved because the isolation presents an essentially resistive load to the detector, completely eliminating all causes of distortion except diode characteristic curvature. Curavture effects are minimized by keep-

Fig. 4. Less than 1 percent distortion at 100 percent modulation is the claimed performance of this cathode-follower plus diode detector circuit. Shunt impedance is eliminated from the diode load (R1) by the direct-coupled cathode follower.



ing applied signal voltage high—greater than 10 volts in most receivers.

Major disadvantage of the circuit is its requirement for an added tube. However, should your receiver use a 6AL5 as detector, it can be replaced with a 12AX7 with little difficulty. The 6H6 can be replaced with a 6SL7.

There is no hard-and-fast rule that the isolation must be between the detector and its load. Similar advantages may be gained by isolating the detector from the *if* transformer as described by Sareda.

In this circuit (Fig. 5), two major advantages appear. Loading of the output *if* transformer is substantially reduced, since it feeds only the high-impedance input of the cathode follower. Differential distortion is also slashed by an appreciable amount, since the detector load resistor (R2) is so much lower than any associated shunt impedance. This means that any variation of shunt impedance with frequency or modulation depth becomes only a minute fraction of the impedance of R2.

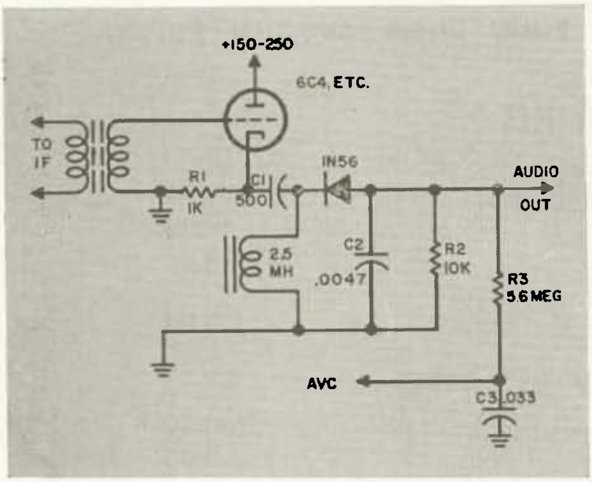


Fig. 5. This cathode-follower detector circuit provides both audio and AVC from a single diode. It eliminates differential distortion by keeping diode load resistance R2 at a low value so that all shunting impedances will have minimum effect

Use of the low-valued load resistor requires that a high-conductance crystal diode be used as detector. If a tube is employed, its forward resistance will be an appreciable fraction of the load resistance and distortion will skyrocket.

No figures for distortion reduction have been obtained for this circuit. However, it appears that its performance should be comparable to that of the diode integrator.

Major disadvantage of the circuit is its complexity, requiring addition of one triode stage and three other components to the receiver. However, it should be a natural for inclusion in a homebrew receiver.

Another approach to detection, basically different from the peak-linear diode circuit, is the "infinite-impedance" detector. Frequently used in hi-fi gear, it is seldom seen in communications receivers because it makes no provision for AVC voltage.

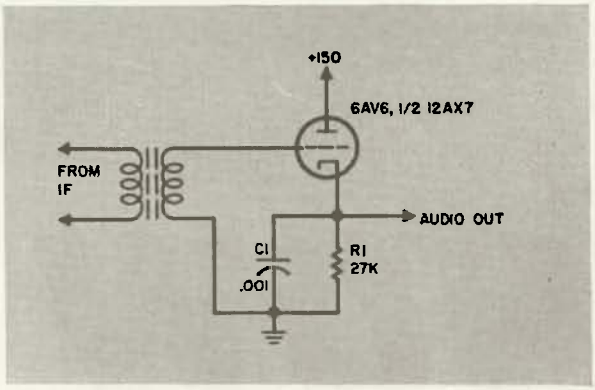


Fig. 6. The infinite-impedance detector appears similar to a cathode-follower amplifier but operates differently. It reduces distortion and increases selectivity, but can be overloaded more easily than the conventional diode circuit.

A typical infinite-impedance detector is shown in Fig. 6. You can see that it appears identical to a normal cathode follower type amplifier—and so far as the circuit goes, it is identical. The difference lies in the tube's operating point.

While circuit constants in the cathode follower are chosen so that the tube acts in a linear manner, an infinite-impedance detector is biased almost to the cutoff point. This is accomplished by the extremely large cathode resistor, R1.

With no signal, little plate current flows and the voltage drop across R1 is small and steady. When an rf signal is applied, more plate current flows at positive peaks, increasing voltage drop across R1. The voltage across R1 reproduces the signal's modulation envelope in the same manner that the envelope is reproduced in a peak-linear diode detector.

Since the tube is operated in cathode-follower configuration with a large amount of feedback, its input impedance is high. As a result, the *if* transformer is not heavily loaded and selectivity is increased. The large amount of feedback prevents overload effects until the grid is driven far into the positive region, at which time distortion suddenly becomes extreme. Since this doesn't happen until input nears 50 volts, its effect is usually absent.

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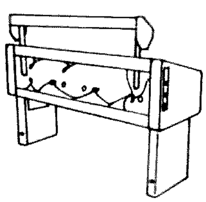

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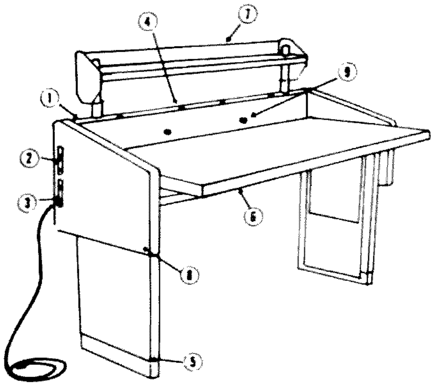

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9. DELUXE model equipped with 3 SO-239 RF antenna lead connectors.
10. EASILY assembled with ½" wrench and screw-driver—all screws removable with coin.
11. PLEASING appearance will appeal to XYL. Deluxe—two tone gray—gleaming white formica top—vinyl trimmed ends. Standard—gray with brown masonite top.
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Additional accessories will be available soon—watch for advertisement. **Specs. and prices subject to change without notice.**

Distortion level of the typical infinite-impedance detector at 100 percent modulation is in the neighborhood of 3 percent. This is not so low as some of the more sophisticated diode circuits, but appreciably lower than the 10 to 15 percent produced by the conventional diode.

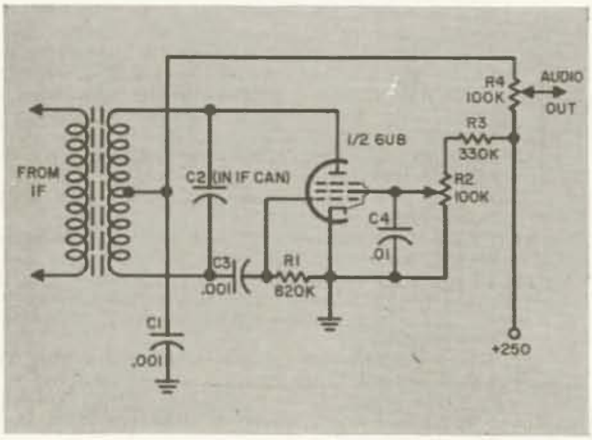
Aside from circuit complexity, the major disadvantage of this detector is that it makes no provision for AVC takeoff. With the receivers using amplified AVC such as the Super-Pro and the SX-28, this poses no problem.

The only other AM detector still in anything like wide use is the superregenerative circuit, developed by Maj. Armstrong. Relegated to the UHF bands before World War II, it was brought back from obscurity for use in Class D Citizens Band equipment and, with some modifications, can find a permanent place in ham equipment.

Too many superregen circuits exist for us to list them all here. One easily-handled version is shown in Fig. 7. Note its strong resemblance to a grounded-cathode Hartley oscillator. As a matter of fact, the superregen *is* an oscillator, with its grid-circuit time constant chosen to produce "squegging" at a supersonic rate. The ear doesn't hear the oscillation or the squegging, and the nearly-infinite amplification produced when the circuit is oscillating makes it possible to hear even the weakest signals.

One major characteristic of the superregen is its characteristic hiss. At one time, they were known as "hiss-boxes." This hiss is actually the noise produced by random movement of electrons in the coil and in the antenna—indicative of its great amplification ability.

Fig. 7. This superregenerative detector for use in VHF mobile receivers combines AVC, noise rejection, and extreme amplification. R2 controls regeneration and R4 is the audio gain contol. The transformer secondary must be centertapped.



The superregen has other advantages besides extreme amplification. It automatically limits its own output, making noise limiters and AVC circuitry unnecessary.

However, in most applications its disadvantages outweigh these advantages. The superregen produces extreme noise output in absence of signal (the hiss mentioned before). It radiates an interfering signal, not only on the frequency to which it is tuned but at all integral multiples of its quench or squegging frequency for several megacycles in either direction. Its sensitivity is low despite the gain because of the high noise output. And finally, its distortion is high. The superregen is definitely not a low-distortion detector.

With a couple of modifications, though, it can fill a major need as the second detector in mobile sets designed for VHF use. In this application, its amplitude limiting and great gain become major advantages. Use of superhet configuration for the receiver eliminates the low sensitivity, interfering radiation, and broad-tuning characteristics of the superregen used alone.

Care must be taken to shield the detector completely. Otherwise, signals at the *if* will leak through and be detected because of the great gain. The *if* frequency to be used must also be chosen carefully. Quench or squegging frequency should be approximately 1/1000 the signal frequency for best results, but in no case should it be in the audio range (or even lower than twice the highest audio frequency desired in incoming signals). This means that the *if* chosen should not be lower than 10 mc and can never be lower than 5 mc if good results are to be obtained.

The circuit shown in Fig. 7 is designed for use with an *if* of 17 mc. It can be used without change through the range from 10 mc upward. Should you desire to change the quench frequency, the components which determine it are R1 and C3.

Automatic Volume Control

While AVC circuits are rightfully a subject unto themselves, they are so closely related to detectors in so many ways that they will be treated briefly here.

The basic AVC circuit is identical to the peak-linear diode detector shown in Fig. 1, except that the AVC output line includes a low-pass R-C filter to eliminate all audio components and leave only the dc voltage developed by the incoming carrier.

The time constants of this filter determine

how rapidly the AVC will act, as well as the speed with which it will release after the signal stops. For communications use with normal AM signals, an overall time constant of about 0.2 second (for both attack and release) is optimum. Shorter time constants enable the receiver to follow fading more rapidly, but result in loss of bass from the audio. Longer time constants emphasize fading effects. However, in hi-fi tuners where excellent audio response is more important than freedom from fading (since most reception is local in nature), time constants for this circuit average one second.

A major disadvantage of the ordinary AVC circuit is that it applies a control voltage for weak signals as well as for large ones. In other words, it cuts back the gain of the set even when you want all the gain you can get.

To overcome this disadvantage, delayed AVC was developed. The delay refers to voltage, not to time. It means that no AVC is applied to the set until signals are above a predetermined level. Past that point, AVC action is normal. One of the best delayed AVC circuits is the sinking diode arrangement, Fig. 3. Another is included in a squelch circuit shown in "The Perfect Squelch" (73, December, 1960, pg. 26).

When receiving CW or SSB, neither conventional nor delayed AVC is in itself acceptable. Means must be found to apply AVC quickly, while retaining it even with no signal incoming. Such circuits are known generally as "hang AVC" circuits because the AVC voltage hangs on for an instant after the signal is gone. These circuits, together with detectors for CW and SSB, must form the subject for another article. **73**

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*Available from Radio Bookshop.

Ham Headlines

If ham radio makes the newspapers in your town please send a clipping to Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Marvin runs the 73 News Service, a montly publication sent to all editors of club bulletins. He will digest the most important stories that are submitted each month for us to print in 73.

Ham Station in Bomb Shelter

A ham station, operating on all amateur bands from Six to Eighty meters, has been installed in the cafeteria, which doubles as a bomb shelter, of the Cleveland Twist Drill Company. There are both indoor and outdoor antennas, just in case. Call letters are K8UFN. (*Cleveland Plain Dealer, Cleveland, Ohio . . . from Parma Radio Club*).

Hams and Doctor Aid Stricken Hunter

W5FFX, W. C. Lendon, at a ranch in Folsom New Mexico put a phone patch through W6MLZ, Ray Meyers, to a doctor in the San Gabriel Hospital. The doctor prescribed emergency treatment for a hunter who had been stricken with a heart attack at the isolated ranch. Another amateur alerted an ambulance which rushed oxygen to the scene. The new Mexico Highway Patrol later notified W6MLZ that the hunter had arrived at the hospital in Folsom and was out of danger. (*Los Angeles Times*).

Tower Legislation

The Menlo Park City Council has decided to make a blanket ruling about ham radio towers. The issue was brought to a head by the 70 foot tower of William Orr W6SAI which the Council ordered him to take down. Orr disputed the ruling and refused to take it down. A second tower was recently discovered by the City Planner, this one only 50 feet high. Since the city height limit is 35 feet this was added to the Orr tower difficulty and a single comprehensive ruling should result. (*Daily Palo Alto Times, Palo Alto, California*).

Letters

Dear Porsche Pusher,

Hullo There! Just grabbed a copy of ur new magazine today (last copy of the October issue) which made me pretty happy. Dunno why I made that trip to the local Clip & Gip joint—but maybe that "One Step Beyond" program knows what it's talking about.

Anyhoo, I'm sure glad that the ex-"Editor of a leading technical magazine in the electronics field," to quote a sports car magazine which once published an article by some guy named Green on Rally(e)ing, is back in the business again. "XX" lost me about the same time that it lost you (well maybe 2-3 minute later), and I've been hoping you would return. I realize that the opinion of a teenager who can't even afford $3 for a subscription may not count for too much, but I sure like the new **"73"** and you can be darn sure that my next $3 is headed directly to you cats.

Speaking of teenagers, why don't you maybe devote some space to this growing facet of the ham fraternity? A quick glance at the local high schools' regional Science Fair will show that we young-uns have a fair amount of know-how.

210 (seventy 3's) . . . Wm. Swope K7HXP
Tacoma, Washington

OK Wm., put down that switch-blade and start writing. A lot of teenagers are doing interesting things if they'd only write 'em up. I've seen some great home-brew stuff built by teenagers, but darned if I have been able to get 'em to article-ize the stuff.

CUT IT OUT!

Yes, cut this out and send it in right away . . . we need it yesterday. The problem is this: we need some facts and figures to help snow advertisers. The main figure we need is one which will give them an idea of how many 73 readers do not carefully read other ham magazines so they can see why, though they may advertise elsewhere, they must also use the pages of 73 to approach our elusive readers. If you don't like to chop up your magazine then send us a postcard. IMPORTANT: send something.

Questionnaire

In addition to 73 I carefully read the following ham magazines ______________

. . . (Oh, while you're sending something in you might as well vote on the articles).

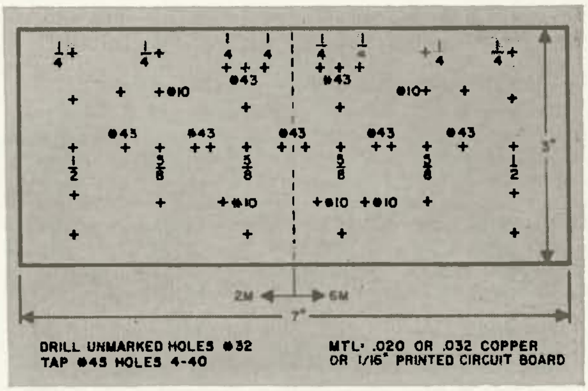
—Nuvistor Converters	—Suction or Whoosh
—Down With Drift	—Xstr Comm. Receiver
—6N2 Complete	—Vertical
—1296 mc	—A-M Detectors
—Goblin Patrol	—T-17 Switch
—Lost in a Tunnel	—Propagation Chart
—8 mc Conversion	—Spot Freq. VHF Nets
—Transistor Freq. Std.	—See-Saw Bleeder

(Please list order of your preference . . . 1-2-3, etc.)

(6 and 2 from page 11)

Construction

The converters are built on a 3"x7" piece of copper sheet with the edges bent 90° for strength. If copper is not available try using printed circuit board as a chassis material, without etching. Drill all holes first; then mount the Nuvistor sockets, filing the necessary slots in the ½" mounting holes. Next mount the shields by soldering to the chassis.



The printed circuit board is considerably easier to solder to than is the copper sheet. Now mount all parts, and wire. The small color coded wires removed from 8-wire TV rotor cable are ideal for the hookup and the coil links. If only one converter is to be built simply split the chassis layout down the center. Except for the extra hole for C9 the 6&2 layouts are identical.

I hope some of you ø's and 1's will build this converter and listen for K8ERV on 2!

73

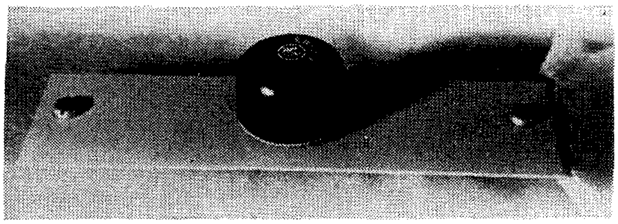
New Product

International Crystal Catalog

If you look carefully in the smaller type in the International Crystal ads you will notice that a catalog is listed as being available. Their new 1961 model is just off the presses and it is a darb. Theoretically you are supposed to be interested in home brew if you read this magazine, thus you automatically become a first class candidate for this home brewers paradise. To be blunt: send immediately for this catalog and join the rest of us in hungrily ogling page after page of goodies. They have dozens of circuit kits in there, both with tubes and transistors. You can build almost anything you want with these basic kits. If this catalog doesn't get you all excited then turn in your ham ticket and subscription to 73, your Novice license has expired. International Crystal Manufacturing Company, 18 North Lee, Oklahoma City, Oklahoma.

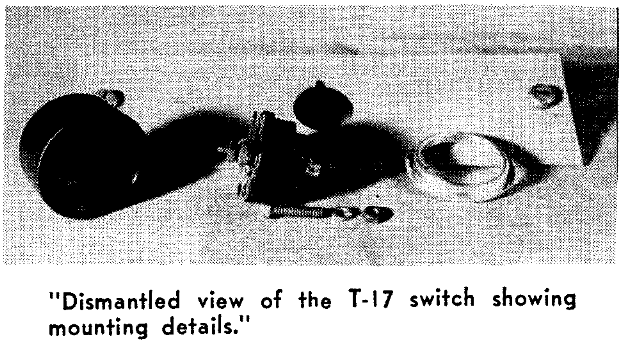
A Versatile Switch from Surplus

THE worthy T-17 Microphone has performed yeoman military service through one war and a major "police action" and, in addition has served many thousands of amateurs as a rugged, high quality carbon microphone for mobile and portable use. However, the best of equipment does give up the ghost or is replaced by newer and better (?) gear. The T-17 is no exception to this and repairs of the models in which the carbon element is assembled in the plastic case are difficult.



"Chassis mounted view of the push-to-talk switch from a surplus T-17 Microphone."

Before discarding this venerable survivor, examine the push-to-talk switch carefully. It is a sturdy double pole, single throw unit that may be easily removed from the microphone and installed to meet any number of push-to-operate requirements. It is particularly suited for use where the precision finger jabbing required with todays miniature components can not be tolerated.

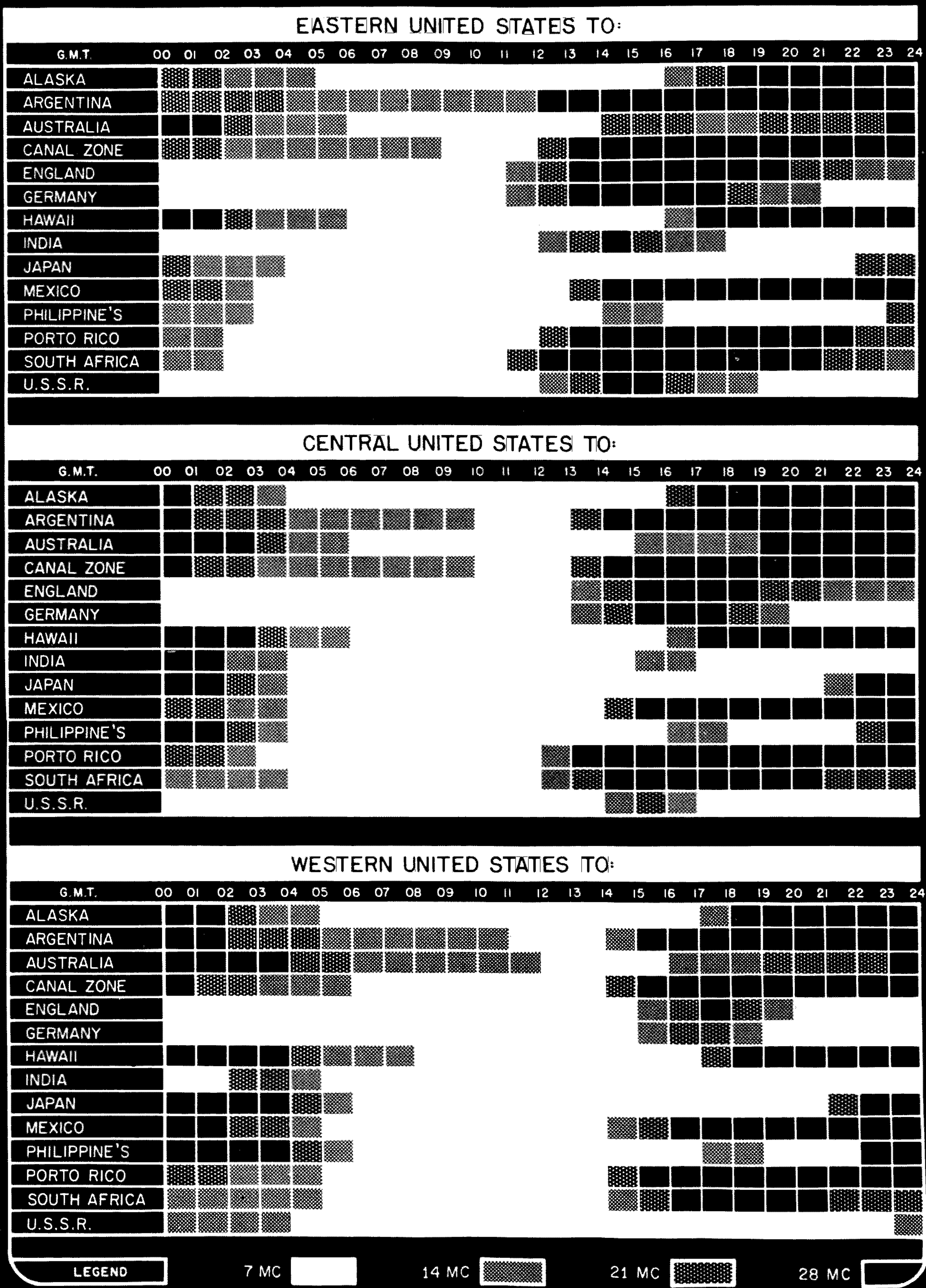


"Dismantled view of the T-17 switch showing mounting details."

The photograph shows the disassembled switch and the mounting cutout required. The other view shows the assembled switch mounted on a small control panel. The switch is easy to mount and where could you buy a better switch for such applications as mobile VFO spotting?

. . . Pafenberg

PROPAGATION CHART



Propagation Charts

David A. Brown K2IGY
60 New York Avenue
West Hempstead, N. Y.

The bands listed are MUFs and a higher band will not work for the time period listed. Lower bands will work, but not nearly as well. Times are GMT, not local time.

These charts are to be used as a guide to ham band openings for the month of January, 1961 to the various countries listed. I will be interested to hear of your results in using these charts and to know what other areas you might wish included in future charts.

Advanced Forecast: January 1961

Good 1-3, 10-19, 23-31

Fair 4-5, 8-9, 20, 22

Bad 6-7, 21

Spot Frequency Operation Of VHF Nets

Robert B. Kuehn WØHKF
1212 Bellows St.
St. Paul 16, Minn.

ONE of the problems faced by users of commercial FM gear in amateur operation is placing all of the units on exactly the same frequency. Slightly off frequency operation with this equipment results in a marked falling off in sensitivity, and in the absence of other symptoms, everything else may be suspected but the true cause.

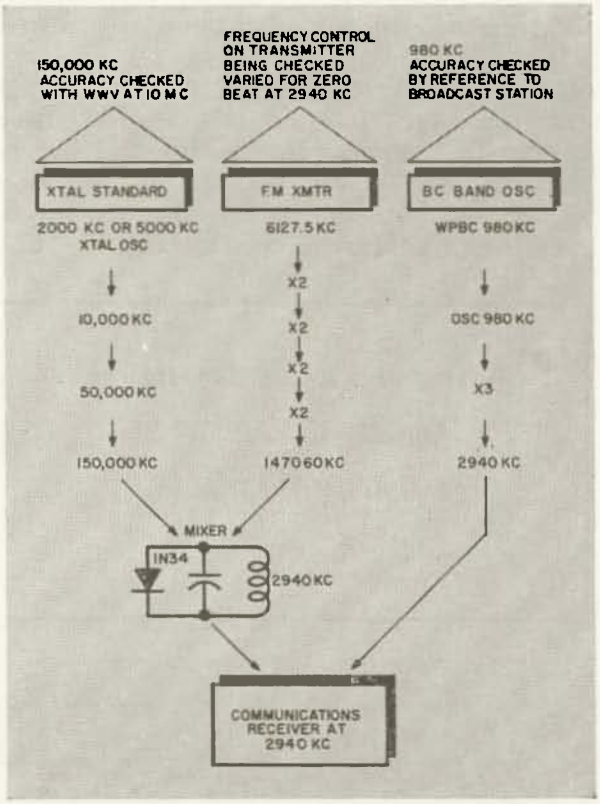
In amateur operation being on the exact frequency is unimportant as long as all stations are on the *same* frequency. A convenient way of ensuring this is to designate one station, usually the net control, as a standard and zero all other units on that one by means of this modified heterodyne frequency standard.

When the outputs of two transmitters within 10 kc of each other are combined in an rf detector the result will be an audible beatnote representing the difference in frequency. When the frequency of one of the transmitters is varied until the beatnote becomes as low as possible and finally disappears, both transmitters will be on the same rf frequency. A mobile can draw up to the curb at the standard station, place this 'difference meter' on the fender or trunk floor and with both carriers on, zero his transmitter exactly on frequency in a matter of seconds. In like manner the mobile can then carry the standard frequency to other fixed or mobile stations. Since sensitivity is no problem, the most rudimentary type of rf detector will do; in fact a portable grid dipper or a field strength meter with phones can be used. The circuit illustrates a tuned circuit, diode detector and transistor amplifier which, together with two penlight cells, can be built into a very small aluminum box. A piece of wire a foot or two long serving as an antenna gives enough pickup for an audible signal in the phones.

When it is desired to establish a net on an exact frequency it does not necessarily demand an expensive frequency meter. It can be done with equipment and parts found in any ham shack. The following procedure is used to set one of our nets on 147,060 kc. With obvious modifications it can be used for most 2 or 6 meter channels.

A 2 mc crystal oscillator is followed by a quintupler to 10 mc, another quintupler to 50 mc and a tripler to 150 mc. Two dual triodes suffice, since little power is needed. A 5 mc crystal could be used as well. A comparison with WWV at 10 mc ensures output on exactly 150,000 kc.

We have a local BC station on 980 kc. A self excited oscillator is adjusted to 980 kc by reference to the BC station and followed by a tripler to 2940 kc. Since all BC stations keep within a cycle or two of assigned frequency, the 2940 kc can be assumed exact as long as zero beat is maintained.



150,000 minus 147,060 (the frequency being checked) is 2940. A small portion of the output of the transmitter and the 150,000 kc output are placed across a mixer consisting of a 1N34 diode and a tuned circuit at 2940 kc. The result is compared in the station receiver (tuned to 2940) with the output of the 980 kc tripler. Varying the crystal of the VHF transmitter for zero beat at 2940 kc will then indicate operation on exactly 147,060 kc. In making a frequency check the receiver is tuned quickly first to 980 kc then to 10 mc and then to 2940 kc for the final check. If a suitable BC channel is not available the self excited oscillator can be kept on any selected frequency by means of an ordinary 100-10 kc standard. 73

(1296 from page 17)

You will note no mention has been made of use of modulated oscillators or radar *if* strips to get going on this band. Amateurs proved this type of UHF-VHF equipment obsolete 20 years ago, so consider such garbage a waste of time. I have e APX-6, much modified, etc., around to work out antenna patterns with and so will you, but consider the time spent trying to talk to someone else with it a waste. If you are going to use ¾ wave tanks anywhere in the 1296 mc portion of your Xmtr. don't use 432 mc equipment for drive to a tripler. Triple from 216 mc to 648 mc and use a doubler to 1296 mcs.

If the above seems like a lot of work and too much trouble—then stand on a mountain and use a flash-light to another such set-up—you will then have communicated on some real-high frequency energy, but meanwhile W1FZJ, W2CXY, W8LIO, W9QXP, K2GQI, W2TTM, K2HAC, K2TKN are involved in the most interesting phase of amateur radio yet. We have standards—the frequency is 1296 mc—exact, and polarization is horizontal when pointing at the horizon due south on a polar mount.

Most of us have no special test equipment, none have any money, any of us are more than glad to prove that any available equipment or parts provided by the few interested manufacturers will or won't work efficiently at 1296 mc, and we all welcome interest by any other amateurs. Please don't write asking for exact info on this or that, for I have no time to describe equipment that is obsolete by the time this gets in print—scream, holler, and insult W2NSD and he will see that articles appear in "73" on anything enough of you have interest in, besides we need the money!

Seriously, Grote Reber summed up the whole situation very well when he was the first amateur working on these frequencies some years ago—"There is much to be done!"

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Feb. 12—The Electronic Emission Microscope.

See-Saw Bleeder

Pat Miller KV4CI
P. O. Box 701
St. Thomas, V. I.

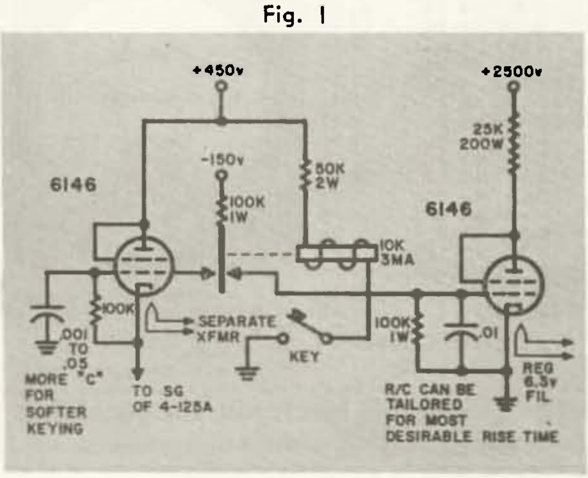
How would you like to save up to ten dollars a year on your ham rig? If you are an active CW ham, the following article will give you some good tip-offs on how to cut the cost of running your rig.

The term "Watts Per Dollar" has been used frequently in construction articles but invariably it has been in reference to the inital cost of the components. Little thought, by radio hams, has been given to the every day consumption of useless watts by their transmitters. The worst offender is the power supply bleeder, frying away and adding useless heat.

Commercial communications companies, with their eyes warily looking at their electric bills, took up this problem a long time ago and came up with what could be called a "See-Saw" bleeder. The design is a simple one and amounts to nothing more than a clamp tube in series with the bleeder which pulls a lot of current under "key-up" conditions and clamps off the bleeder under "key-down" conditions. We radio hams use this device as a source of screen voltage from the HV supply but then blindly proceed to add another bleeder in parallel with the clamp circuit. Such design does nothing but add heat and strain to the power supply.

At KV4CI one of several methods of putting a "See-Saw" bleeder to work was put into action; see Fig. 1. This circuit is a bit fancy as it uses a keyer tube to key the screen of the 4-125A final. However, the same bias that keys the keyer tube is used to unclamp the bleeder clamp tube. Under "key-up" conditions the bias cuts off the keyer tube. Under "key-down" conditions bias is shifted from the keyer tube, allowing it to conduct, and is put on the grid of the bleeder clamp tube cutting off the current in the bleeder. A small plate relay, single pole, double throw, is used to do the keying and steals a few mills from the low voltage power supply.

Fig. 1



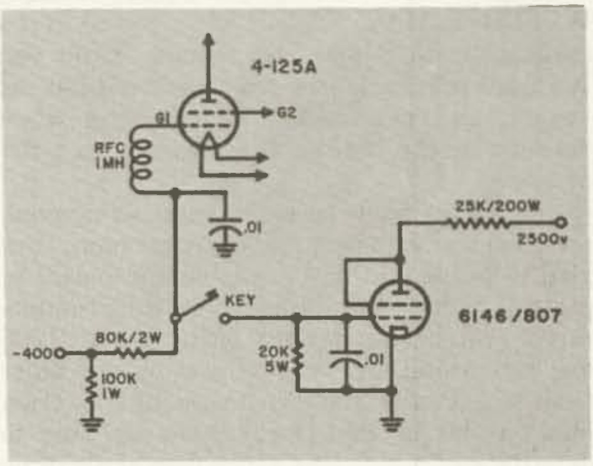


Fig. 2

For those that use grid block keying a suggested circuit is shown in Fig. 2. Here the normal grid leak is inactive under "key-up" conditions, acting only as a grid return for the bleeder clamp tube. Under "key-down" conditions the bias source is practically shorted out leaving only enough protective bias to keep the ampilfier cool if it should accidentally be off-tune. The same left over bias is used to clamp off the bleeder tube.

Fig. 3 is another variation wherein the voltage appearing at the plate of the clamp tube under "key-down" conditions is used to supply the screen voltage to the amplifier. A voltage regulator tube cuts off the screen voltage entirely under "key-up" conditions while a small amount of negative bias is impinged on the screen to assure full cut off. If you project your imagination on your own you can come up with at least a half dozen variations on this theme with one of your own possibly more suited to your circuit design.

(Continued on page 59)

Letters

Dear Wayne:

It's a helofanote when I have to get the information on 73 **Magazine** from England.

I had heard a few feeble rumbles that you had started ram-rodding a new rag, but, think I could find anyone who knew the slightest thing about it? HAW!

Well, I finally snagged a copy of 73, thanks to W3NNK, who picked it up off a news stand back east and brought it with him to Texas. I was rather pleased with the familiar format and policy outline. I only hope you continue to follow your implication that 73 **Magazine** will deal mainly with construction-type articles of advanced technical interest. Some of the other available magazines are getting rather pedantic.

A number of years ago, back before you were on RTTY—and still had hair, there were a couple of interesting, to me, columns in CQ. One was "Pages From an Engineers Notebook," dealing with old, new and unusual circuit applications, and mainly consisted of chatter and scribbled sketches, very much like coffee-break conversation. The other column, "The Brasspounder," was concerned with our primary mode of transmission, CW. It showered roses or threw brickbats at CW operators, with no holds barred. It was a very frank discussion of good and bad signals and/or operating techniques heard or worked by the writer of the column. I used to chat with him every evening on 7020 kc but haven't heard him for years. For that matter, I've been out of the States for years—met you in Wiesbaden, Germany last year. How about considering something like that for 73?

Wayne, you can see I'm rather partial to CW, and it has been a long long time since anyone had actively and frankly discussed the "art" of transmitting GOOD CW. Believe me, it was a pleasure the other day to hook up with an old retired Master Sgt. out in Alpine, Texas. It was the first time in years I was able to take the weights off the "bug" and blast. (I also have a COMPLETE RTTY station—professional grade.)

I have no arguments about A3, A3a, or A3b, but isn't it a fact that when the bands have gone dead, a few CW men are still manfully chugging away, reading copy, half imagination and half noise breaks. That 20 db advantage over AM is mighty hard to deny.

Off the record, Wayne, it looked like you shook the bucket a bit to come up with that collection of articles in the 2nd issue of 73, but it was a darn good start in the right direction.

Dwight B. Olson W9EAM
Von Ormy, Texas

Lots more in the bucket, Dwight . . . Wayne.

Wants

Dear Wayne,

Your "73" is great. I like it. Le's have some RTTY articles; 144 mc and up; information on how to build waveguides and cavity resonators; most common troubles with TT machines.

Stan Wilson W9IFZ

Somebody write those articles for Stan . . . please? . . . ed.

Dear Wayne:

Everywhere I go on the air, people are mentioning your magazine! I never fail to hear a fellow say 73, right before he signs off. . . .

Al Brogdon W4UWA/K3KMO
State College, Pennsylvania

Subscription Department

Big Brother is watching closely to see if you are really in there subverting other hams with the insidious germ of home-brewitus. Please note the secret invisible ink markings on the subscription blanks so we can tell whether you have been leading to the mental ruin of your friends. We can tell, so you'd better get the old scissors out and get your friends in the same leaky boat with you. (Huh?).

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(SEE SAW from page 56)

Not only is this a money saving device, it is also a method which improves the overall voltage regulation on a CW rig. For example at KV4CI the "load-no load" conditions for the 4-125A final were 2400 volts loaded to 250 ma and 2700 volts no load except for regular bleeder. The picture changed dramatically after installing the "See-Saw" bleeder with 2600 volts at 250 ma and 2750 volts under "key-up" conditions. So I enjoy the double bonus of money saved and a couple hundred more volts on the final to help fight the QRM.

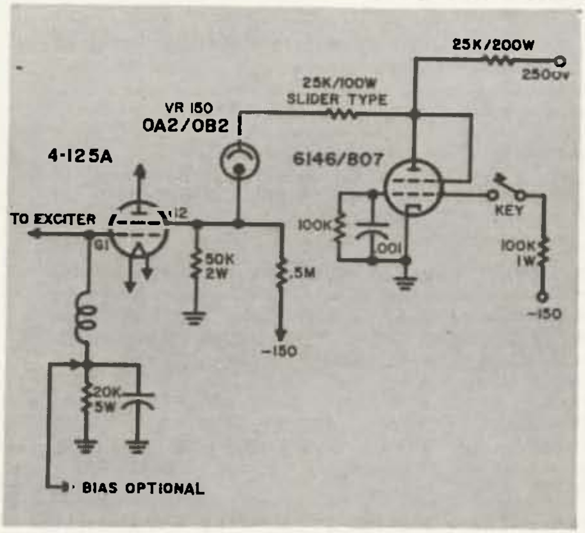

Fig. 3

You will note that 6146's are used in my circuits. I happened to have a half dozen used ones laying around. 807's, 6L6's, 6Y6's, all of them will do the job equally well. 73

(6 and 2 from page 15)

The clipping level is then increased with the clipping control, just above the point where the two bars meet, but do not overlap.

Tests were run on both 6 and 2 meters and the stations worked were asked for a report on signal strength, frequency stability, modulation percent and quality. Results were really great. Stations one hundred miles away and on the other side of 2000 foot mountains were worked with S9 plus signal reports! Most VHF amateurs agree, as I do, that 100 watts on 6 and 2 is almost ideal. Increases in power beyond this point do not result in much improvement, unless the power is increased to 5 or 6 hundred watts. (Oh the TVI!)

I can report TVI from the rig is *very* low. Trouble was experienced on channel two when operating on six meters, but channel two is a fringe area station in my area, being 80 miles away. This was the only channel effected when the rig was properly tuned and matched to the antenna. For a rig which will enable serious work on 6 and 2 meters, you will have to go a long way to beat this combination. 73

(DRIFT from page 13)

tages vary, and this resistor between cathode and circuit swamps out the interface resistance variations. Naturally, the added resistor is NOT bypassed for rf.

The closing entry in this list of stabilizing techniques is the idea most hams think of first —but it comes last for a reason. The reason is this: If you employ the first six gimmicks, you won't need this one!

However, if you don't want to go through the trial and error technique of Number Five, you'll find this one helpful too.

Simply regulate the voltage applied to the oscillator and to the mixer screen, if it's not already regulated.

For best results, use the VR tube closest to the designer's voltage rating for the oscillator. If this rating doesn't happen to be 65, 75, 90, 105, or 150 volts, though, take the next-lower VR tube.

And if there's not room on the chassis for another tube, you can still regulate the voltage. Use two small neon tubes (NE-2 type works fine) in series, and place them under the chassis. Each neon tube will regulate at about 60 volts, giving you 120 volts for two in series. In many cases, you'll find, just 60 volts on the oscillator gives plenty of output. If it does, use it that way—you'll cut down the heat problem with the lower input.

At this point, you may be wondering just what to expect in the way of results from these tricks. While no promises can be made (there's no way of knowing how bad your present receiver is!) I *can* show you what improvements these tricks made for me.

Try them—they'll probably do as well or better for you! 73

Letters

Dear Wayne,

Your first two issues of 73 have been just dandy. I'm glad I subscribed early. In the future I hope you and 73 lay off all sponsoring of contests and awards for operating. It's so bad now that a ragchewer can hardly open his station without being besieged with contest numbers and requests for numbers. Or "Say, OM, just work none more of us Tail-Twisters and we'll send you a tail for you to twist for yourself." I'm not against good clean fun, and contests can be fun, nor am I against awards for outstanding achievement, but the present situation is amateur radio is slightly ridiculous. Don't make it worse, Wayne.

Harvey Pierce WØOPA

OK Harv, we'll curb what little enthusiasm we might have had in that direction. I've been proponenting shorter contests as a means of alleviating the congestion that has built up. Many of the contests that are with us today (on a yearly basis) are hangovers from the dim dark ages of ham radio when it took two long weekends to work any quantity of stations. Nowadays a good op can work more stations in one night that the winners used to work during the two contest weekends. Apparently the footprints in time are frozen and unless a clamor is set up by disturbed inhabitants of our bands (like yourself) these things will go on forever. Note the SSB and VHF Contests which I helped set up a few years back, both of which are short and popular. . . . Wayne.

Advertisers Index

Alco 55
Alden 45
Allied Radio 64
Alltronics-Howard 59
Alva Radio 59
Amber 61
Barker & Williamson 43
Candee 50
Central Electronics 5
Clegg Laboratories 55
Columbia 53
Cushcraft 61
Dale 53
EICO 2
Evans 49
Excello 59
E-Z Way Towers 6
Fair Radio 53
Globe Electronics 47
Globe Industries 57
Graham 59
Ham-Swap 61
International Crystal . . . . . . Cover II, 1
Lafayette Radio 7
L-R Electronics 53
Neil 48
Peterson . . . . . . Cover III
Pierce Schools 62
Radio Bookshop 60
Shorecrest 61
Spera 62
Subscription ad 58
Telrex 53
Texas Crystal 51
Vesto 49
Western Radio 57
73 Subscription 58

Other Ham Publications

RATHER than devote half or more of 73 to the printing of news of interest to specialized groups we believe that it is our function to do everything possible to encourage the publishers of bulletins which cater to these interests. These bulletins bring you the news you want in far greater detail and in much less time than is possible in a monthly magazine where it usually takes two months for news to get into print.

HAM-SWAP. Published by Ham-Swap, Inc., 35 East Wacker Drive, Chicago I, Illinois. Editor is Ed Shuey, K9BDK. Subs are $1 per year by 3rd class mail, $3 for 1st class, $5 airmail, and $7.20 special delivery. Published once a month. Contains classified ads entirely. This is your best bet for an inexpensive way to sell or swap some gear in a hurry. Within two weeks people are answering your ad.

FLORIDA RTTY BULLETIN. Fred W. DeMotte W4RWM, P.O. Box 6047, Daytona Beach, Florida. $3 per year including membership in Florida RTTY Society. Mostly operating news with a bit of technical info now and then. All TT men should be getting this.

SOUTHERN CALIFORNIA RTTY BULLETIN. Merrill L. Swan W6AEE, 372 West Warren Way, Arcadia, California. $2.75 per year, not including membership in Society. Operating news and some technical articles. This is the oldest TT bulletin going. All TT men should also get this one. Monthly.

73 HAM CLUB BULLETIN. Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Sent free to all editors of ham club bulletins monthly to keep them abreast of what is going on with all the other ham clubs. This is an excellent source of news for putting together your club bulletins. To subscribe to this news bulletin just send a copy of your own club bulletin to Marvin.

WESTERN RADIO AMATEUR. Don Williamson W6JRE, 10517 Haverly Street, El Monte, California. Monthly. Subs are $2 per year, $3.50 for two years, $5 for three years. Operating news of west coast activity, columns on DX, SSB, YL, and some articles. 48 pages.

SIDEBANDER. Official organ of the Single Sideband Amateur Radio Association, 12 Elm Street, Lynbrook, L. I., N. Y. Subs include membership to SSBARA: $3 per year. Monthly. Primarily operating news and chit-chat for the SSB DX gang.

THE MONITOR. Mar-Jax Publishers, 507 West Davis Street, Dallas 8, Texas. $1 a year, 3 years for $2.50. Monthly. Largely operating news. Columns: YL, Club Meetings, Arkansas News, Mississippi News, Florida News, DX, Missouri News, MARS, California News, Louisiana News, VHF News, Oklahoma News, Rio Grande Valley News, Novice News.

VHF AMATEUR. 67 Russell Avenue, Rahway, New Jersey. $3 year. Monthly. Operating news for VHF men. Some technical info.

DX-QSL News Letter. Clif Evans, K6BX, Box 385, Bonita, California. Published quarterly. 40¢ each; Annual subscription $1.25 (four copies) by first class mail ($1.50 for DX stations). Lists all QSL Bureaus, managers for rare DX stations, etc. Why not send your old Callbook to a DX ham? Write Clif for the name of someone who needs it.

DIRECTORY OF CERTIFICATES AND AWARDS. Clif Evans, K6BX, Box 385, Bonita, Cal. Complete Directory plus one year of revisions (quarterly) $3.50. Add 75¢ for 1st class mail; $1.25 for airmail; DX stations 1st class mail add $1.00. Needless to say, this is the most complete collection of data on the hundreds of certificates and awards available.

MOBILE NEWS. Published monthly by the Amateur Radio Mobile Society, 79 Murchison Rd., Leyton, E. 10, England. Joining fee and 1 year sub. is $2.50.

DX BULLETIN. Don Chesser W4KVX, RFD 1, Burlington, Kentucky. DX news in depth. Published weekly. 3rd Class mail $5 year; 1st class $6; Airmail $7.50. DX rates on request.

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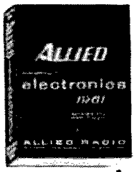

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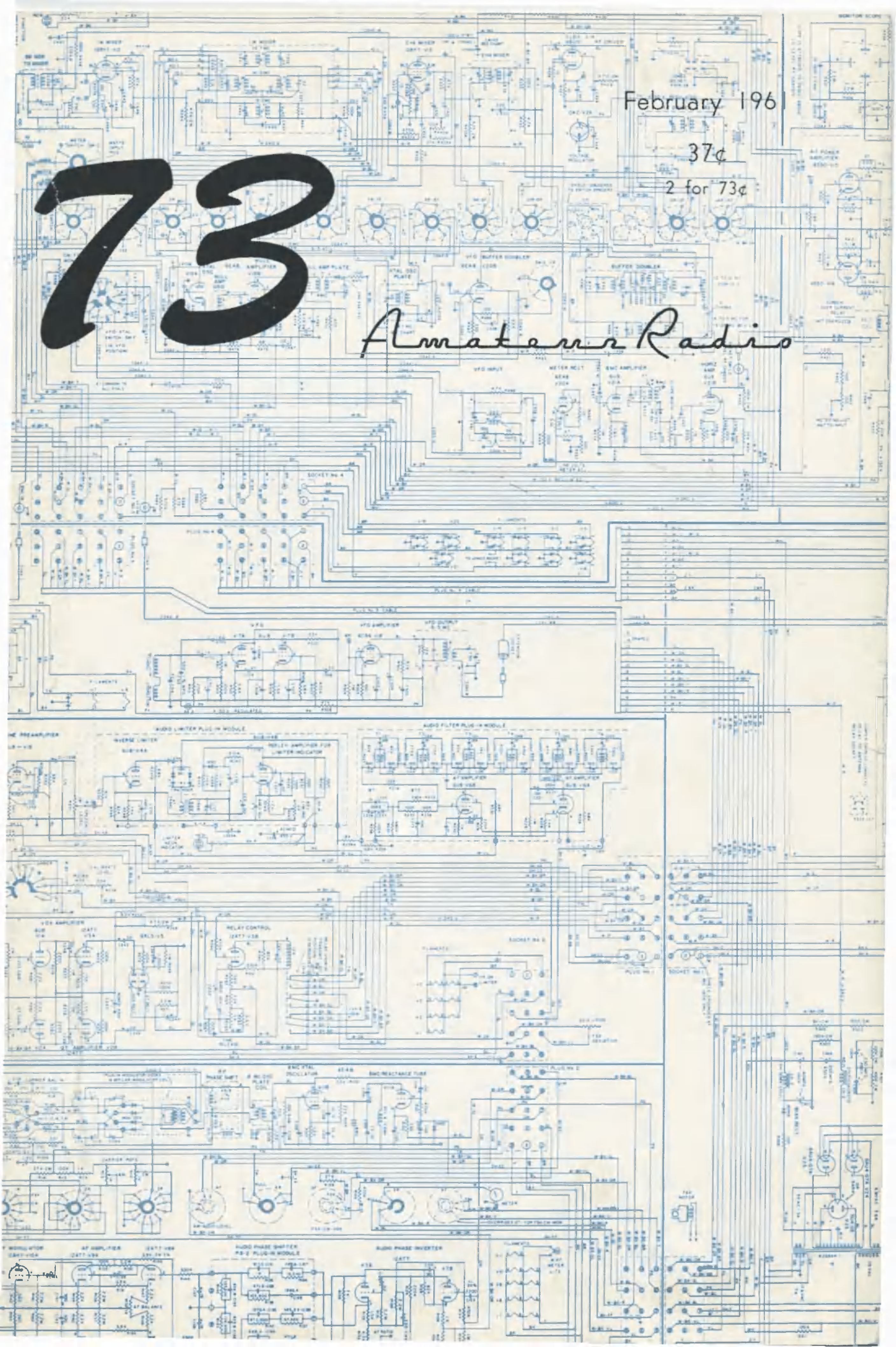

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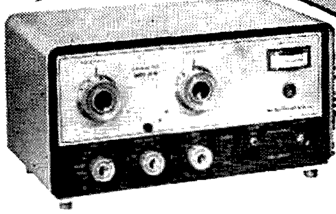

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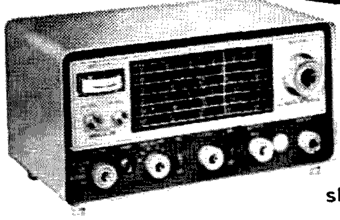

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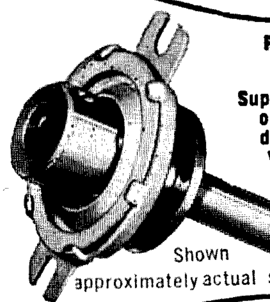

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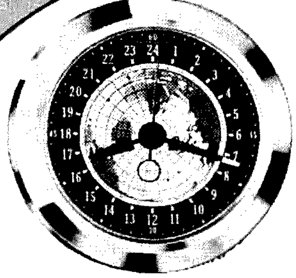

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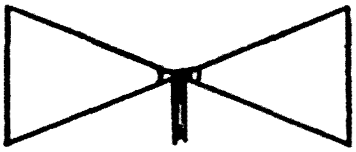

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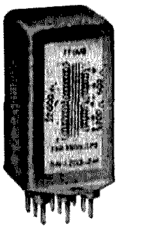

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SAY! YOU SAW IT IN 73

73 Magazine

1379 East 15th Street
Brooklyn 30, N. Y.

February, 1961
Vol. 1, No. 5

Table of Contents

Rolling Your Own — We're determined that you're going to build something.	Jim Kyle K5JKX/6	11
Amplifier for Varicap Modulator — More gain for the modulator in our October issue.	Robert Baird W7CSD	16
World's Simplest Phone Patch — Average construction time: five minutes.	J. Kyle K5JKX/6	17
Two Meter Pip-Squeak — Complete phone rig using only three 6CX8's.	Ray Fulton K6BP	18
Squawk — Guaranteed Rouser. We should needle Ken into writing more like this.	Ken Cole W7IDF	20
Six Meter Converter — For the car . . . operates with only 12 volts on the plates.	Kyle K5JKX/6	22
Heath Phone Patch — Heath does it again. Works fine for SSB also. Hey Heath, where's the ads?	Allie C. Peed K2DHA	24
Life Insurance for Transistors — These little rascals are delicate, so watch your step.	Roy McCarthy K6EAW	26
Beat Generation — Big technical article on SSB and CW detectors.	Staff	28
Updating the Absorption Wavemeter — Real handy piece of test gear, and easy to knock together.	Edward Noll W3FQJ	34
Interference Chaser — Easy way of getting audio break-thru out of TV sets and things.	K5JKX/6	35
Getting the Most Out of Your Mobile Whip — How to make the best of a miserable situation: a short vertical antenna.	Charles Spitz W4API	36
How Modern is the VFO? — Not very.	Howard Pyle W7OE	38
EICO Grid Dip Oscillator — Our Associate Editor is still building up kits and liking 'em.	Don Smith W3UZN	42
Power for the Pro — Super-Pro owners, take note.	James Kyle K5JKX/6	44
Differential Switching — Using polar relays for sensitive switching at different current levels.	Roy Pafenberg	46
Propagation Charts — What time to where on what bands . . . probably.	Dave Brown K2IGY	56

Misc.:

Table of Contents	3
Editorial: W2NSD	6
Keeping panels from being scratched	33
Mounting feet	40
Ham Shacks	43
Nibbling tool	51
Letters to the Editor	53
Flying Hams	54
AF MARS Tech Net Schedules	57
Crystal Grinding Powder	57
Coil Data for December Capacity Meter	59
List of Maritime Mobile Stations	59
Accurate Crystallization	59
Subscription Department	58
Other Ham Publications	61

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COVER: Circuit diagram of the Central 200V transmitter. We finally got an advertised product on the cover!

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VHF
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AVAILABLE!
MOBILETTE 61
ANTENNA
RECEIVER
OFF
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MOBILETTE 61

. . . de W2NSD

Bootlegging

Cheating is a tried and proven method of getting things that you don't want to bother to work for, so why should I make a big fuss because a few of the guys "fix up" a Technician test for someone? What's the harm? Who does it actually hurt? Isn't it better to forget about it and not wash our dirty linen in public?

Nuts! If you'd give it a little thought you'd see what a terrible long range effect this creeping prostitution of our hobby will have.

Have you ever stopped to think what it is that makes ham radio so different from every other hobby? After you get through with a lot of hemming and hawing you will recognize that it is the fraternal spirit that makes it so enjoyable. And where does this spirit come from? I believe that it stems from a common love of radio. Perhaps "love" is a bit strong for you, but how else can you describe the driving force that makes you spend a good portion of your life in such a highly technical pursuit?

It takes "love" to keep you up all night working DX or to get you to brave high winds and freezing snow to operate from a mountaintop during a VHF contest. It takes "love" to send 2000 messages a month over the nets. How else do you explain the thousands of unbelievable feats that make up amateur history every month?

When you meet someone else who shares your love you feel a rapport . . . we call it "fraternity." After experiencing this a few hundred times we get conditioned to accepting all amateurs as members of our fraternity. We accept them immediately as friends.

But what about the chap who doesn't have this love? How do we feel when we meet someone who has never cared enough about our hobby to learn the basics? We try to experience the usual rapport and we meet a cold rebuff. I was so shocked the first time that I ran into this in quantity that I didn't know what had happened. I felt shattered. What had happened to ham radio? I was among strangers.

As you know, I get to almost every large hamfest and convention that is put on. I go to sell subscriptions, to talk with as many people as possible and thus get ideas for the magazine, to promote more good articles, etc. After several years of this I have a pretty good idea what it feels like to talk and be with fellow hams.

Then recently I went to a VHF picnic. There I was rudely introduced to a new breed of "ham," the smirking Technician who arrogantly admits that he doesn't know anything about radio and doesn't want to know anything. He doesn't read the ham magazines because they are all too technical for him.

Somehow or other we have gotten a few amateurs into our hobby who have been giving these chaps their licenses. I mean *giving*, not adminstering. Every time this happens we turn loose a monster in our hobby who will permanently break for many amateurs the delicate rapport that makes our hobby so different.

What's to be done? For one thing you can take the bull by the horns when you run into an obvious bootlegger who has cheated to get a ticket. A note to the local FCC office suggesting that this joker be called in for a supervised test will probably bring a letter requesting him to come in in thirty days for retesting. Then he will have to buckle down and learn the necessaries or be exposed.

I'd like to see some changes in our regulations which would make this situation more unlikely. For instance, if it were required that three licensed amateurs be present for the exam there would be only a small fraction of the present difficulty. This would, in general, encourage clubs to give license exams and would help build up club activity. Bootleg Technicians don't go in much for clubs, it's too easy to get found out that way.

Another big step forward would be a drastic cut in that 30 day grace period that the FCC allows suspected cheaters, plus revocation of the license of the amateur who signed the test.

Lest there be a general rustling among the Technician ranks, let me point out that all this is about *bootleg* Techs, not honest ones. I have the greatest admiration for the job of developing the VHF and UHF frequencies that is being done by our Tech licensees.

Survey

Well, the Fearless Survey is now four months old and we haven't lost a scrimage yet. Every month since the inception of 73 we **have had more pages of technical and consruction articles than either of the other two ham magazines. Let's review the box score.**

	73 Magazine	Brand X	Brand Y
October 1960...	46 pages	37 pages	26 pages
November 1960.	38 pages	33 pages	35 pages
December 1960.	33 pages	28 pages	23 pages
January 1961...	39 pages	35 pages	30 pages

We've proven our point, so we'll shut up about the whole thing for a while.

Attend the 10th Annual Single Sideband Dinner March 21st . . . Statler Hilton, New York City

Phoenix in May

The Phoenixians are hosting a major gathering of the clan this May. The event will be held under the formal name of the Southwestern Division ARRL Convention. No wagon wheel (see photo) will be left unturned to make this an outstanding weekend. Of course all will not be joy and sunshine . . . the angry editor of 73 will be there just in case any non-subscribers dare to show their faces.

Mrs. Sidney Peebles K7NOJ of Phoenix, Arizona, on her way to the fabulous Convention in Phoenix on May 26, 1961. Note Communicator in the English Governess Cart with her

December Feedback

The votes are in for December and the big winner is a stranger to our pages: Jim Kyle K5JKX/6. Jim also made third place with his second article. Quite a performance! When you consider that he won first place in the October 73, second place in November (he later pulled into first place, but the votes had been tallied and the results printed) and is doing very well in the January issue with his "Lost in a Tunnel" article, you can see that he is riding high. Second place in December, by only one vote, was the ZL1AAX Low Noise Two Meter Converter. All articles in the issue received votes in the first five places! K8ERV's Capacity Meter came in fourth and W3HIX's 220 mc Transistorized Converter right behind it in fifth place. All were very close together though and a few votes would have changed things completely. How about your vote for this issue? See page 51.

Short Wave Listening

Those of you whose literary horizons extend a shade beyond the ham magazines may have noticed ads in many popular magazines by the Hallicrafter's Company offering a record about short wave listening for 25¢.

(Continued on page 49)

A handy guide to happy homebrewing

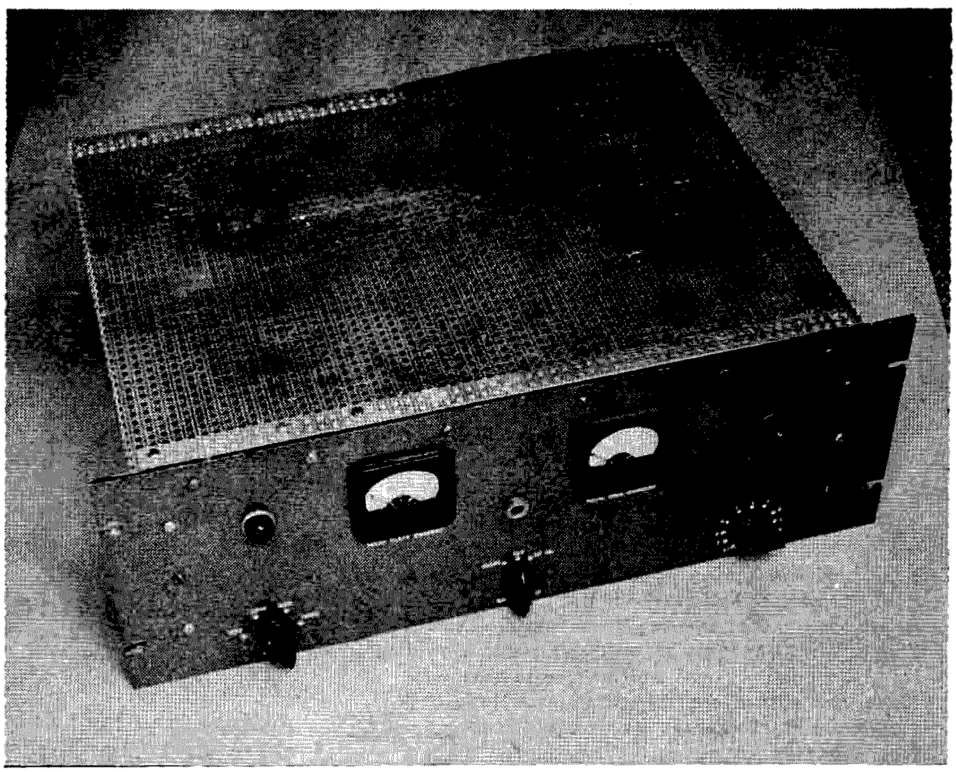
Rolling Your Own

So you'd like to build all your own equipment, but you can't find anything in the books or magazines which fits your needs.

Ever think of designing your own?

Maybe you've entertained the idea, and decided it took a few engineering degrees as well as a complete technical library and well-equipped test laboratory.

If that's the situation, hitch up a chair, you've got a surprise coming.



Jim Kyle K5JKX/6
1851 Stanford Ave.
Santa Susana, Calif.

The people who design rigs featured here—and elsewhere—aren't high-paid engineers. Most of them are hams just like you. Designing any piece of radio equipment from a crystal set to a kilowatt sideband rig, is a simple process when you break it down to fundamentals.

And by doing it yourself, all the way, you'll get more out of hamming. There's a special feeling you get when the fellow at the other end tells you, "Best signal I've heard for a while!" and you know every bit of your gear came right out of your brain.

If this feeling isn't enough, there's always a chance of making a buck. Wayne and the editors of the other radio magazines are always in need of good, original construction articles.

So let's take a look at this business of rolling your own. To start with, what do you need?

You can get as many answers to that question as there are amateur designers, but my answer is this: a ream of scratch paper, a dozen long, sharp pencils, a set of tube charts, and an inventory of your junk box.

Sure, there are other things which will make it a little easier. If you have a good-sized technical library, or drafting equipment, or a slide rule, and know how to use them, bring them along. But you don't really have to have them.

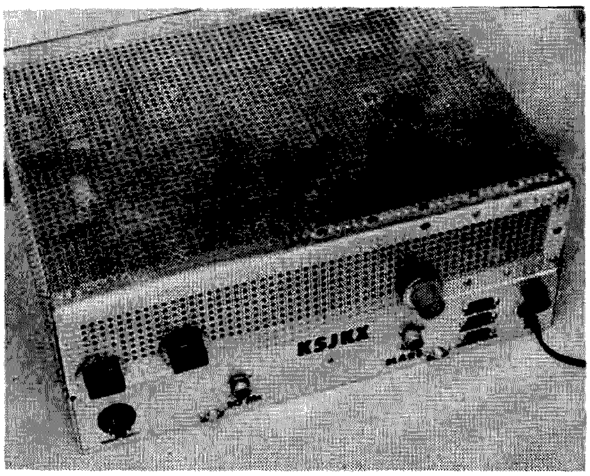
The first step is to take pencil and paper and list the five basic things about the piece of

gear you're going to design. You can unplug the soldering gun, incidentally, for this is a lengthy process—but it's the most important step of all.

These five basics are: Purpose, power, cost, size and features. They determine everything which follows.

Under purpose list exactly what you want the finished item to do. At this point, never mind if it sounds impractical. You never know what's practical and what isn't, and at this stage you're drawing up the exact specifications you're going to work toward.

The purpose will help determine the power, and so will the cost. This is frequently a difficult item to decide on—it may help to remember that in case of transmitters, a kilowatt is only 10 decibels more powerful than a 100-watter, and only 20 db above a 10-watt rig. In S-units this figures out to less than 4 S-points—and band conditions in operation can easily make that difference smaller.



Rear view of the rig shows control circuit connections and little-used controls. Knobs protruding through shielding are, from left, 6-meter final tuning, 6-meter pi-net loading capacitor, and at right, MARS final tuning. MARS pi-net capacitor is trimmer set from under chassis. Plug at left connects to modulator and power supply. Phono jacks at bottom are to receivers. Coax connectors are for antennas. Three AC sockets at right are receiver muting, top; control line (for accessories) and control switch, bottom. Beneath fuse plug is auxiliary 115-volt outlet for receiver, etc. Shield cover is normally buttoned down as at right; left was loosened for internal photos.

Power sources also fall into this heading. There are three basic types: ac line, storage battery, and dry cells. Obviously no one will try to run a kilowatt from dry cells, but careful consideration of available power in relation to the power output you want is necessary in every case. After all, kilowatt-hours cost money, too, even if you're strictly in fixed operation.

Cost is virtually self-explanatory. The junk box can help here, as can scrounging from fellow hams. But it's well to put down on paper exactly how much you're willing to spend on this piece of equipment. This helps in case you have to buy some special part to get the performance you want. And at this stage, nothing is definite yet.

Size is something to think about, too. You can pick a cabinet and try to stuff everything inside, or you can figure out the circuit and then discover you've built a "Mack truck portable." And in case of mobile gear, sometimes the space available determines all the rest of the circuit.

Most difficult of the basics to decide on is "features." This includes consideration of VFO or crystal control, VOX operation, differential keying, all the little "extras" which sometimes add to convenience of operation and sometimes are nothing but a nuisance. The sky's the limit, but it helps to take a few days and be certain you want what you want before you waste time going ahead.

About here is a good place to give you an example from my own experience, showing how to list the basic items.

I wanted a six-meter rig which would also operate on air force MARS frequencies, and since at the time I held a Technician license I had no special use for the lower ham bands.

Purpose of the unit was defined as: operation from 50-54 mc. and on spot frequency of 4.4175 mc. with enough power to give reliable communication at all times.

Power was a question. Since I had a good supply of 6146 tubes, they were certain choice. At this stage, I chose to use two in the final stage for a nominal 100-watt power.

Cost was simple. "As small as possible." However, I was prepared to spend up to $100 on the rig if necessary.

Size, also, was to be as small as possible within reason. I had a seven-inch opening on my relay panel, and took a seven-inch relay panel as the target to shoot for.

Features was the point where I went to town. I chose first simplified controls with broadband tuned circuits. Bandswitching between MARS and VHF. Self-contained crystal bank. Power selection. Operation on phone only.

With these points listed, I mulled the idea over for several weeks, taking every opportunity to doodle out new ways of achieving the aims.

The first major change was to recognize that 100 watts was only 3 db better than 50 watts, and cut down to a single tube final. This was for purposes of easier operation, by eliminating possible unbalance problems and high

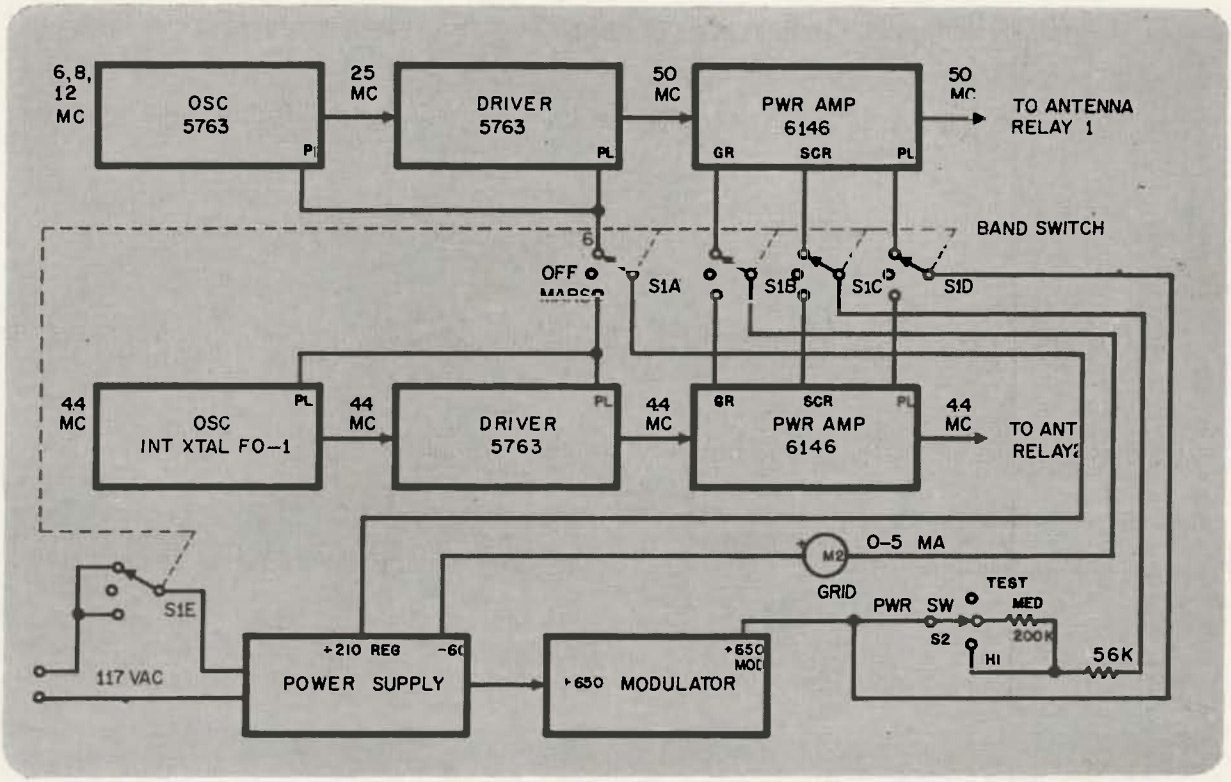


Fig. 3.

capacities in the VHF stage, and for lower cost due to the reduction in power supply requirements.

Another feature added was a trick bandswitching circuit, but we're getting ahead of ourselves. . . . . .

After you've thought over your specifications for a while, making whatever changes you want to (it's a lot easier now than it is when you get to the metal-working stage) it's time to start drawing diagrams.

Any of the recognized ham radio handbooks has enough material on basic circuits to get you started, so I won't repeat that here. A point I've found helpful in sectionalizing the design and making it easy in all respects is to draw a "box diagram" of the unit at this stage.

The box diagram is simply a drawing with a "box" for each stage of the unit, and each box labeled with what that stage is supposed to do.

In drawing the box, it's helpful to start back from the output stage to determine requirements as you go.

Here's where the tube charts come in handy. Pick your output tubes to fit your power requirements, then check to find out how much power they take to drive them properly. Most charts give this information directly in watts.

Remember, though, that these watts have to get to the grid. To allow for inevitable losses, it's a good idea to have at least five times that much power available from the driver stage at low frequencies, and at least 10 times as much at VHF.

This requirement tells you what tubes are suitable for drivers. You keep up the process for two or three stages until you're back to the oscillator, and that's a different problem.

Now, with your box diagram and your tube charts, is the right time to design the power supply. Be sure not to exceed tube ratings unless you're a millionaire and can afford to replace the bottles every five seconds. I once knew a fellow who got 500 watts out of a 6L6, he claimed, but the tube didn't last through the "C" of a short "CQ."

At this stage, you have a collection of boxes drawn with labels ranging from "oscillator" to "final", but no circuits for any of them.

Blending the handbook basic circuits is easy, now, much more so than the customary method of taking "this" from one published rig and "that" from another, then hoping they'll work together.

All you have to do is work from the antenna back, picking the circuit you want for each stage. Pi-network or link coupling; capacity coupled drivers or untuned links; all of these choices are up to you, based on the information in the handbooks and the purposes you have in mind.

The important thing is that with power requirements and tube ratings in mind, you've already guaranteed the thing has an even chance of working right the first time around. And, barring wiring mistakes, you know you're not going to blow anything up.

Getting back to my example, the box diagram of this rig is shown in Fig. 3. This shows the trick bandswitching I mentioned a while

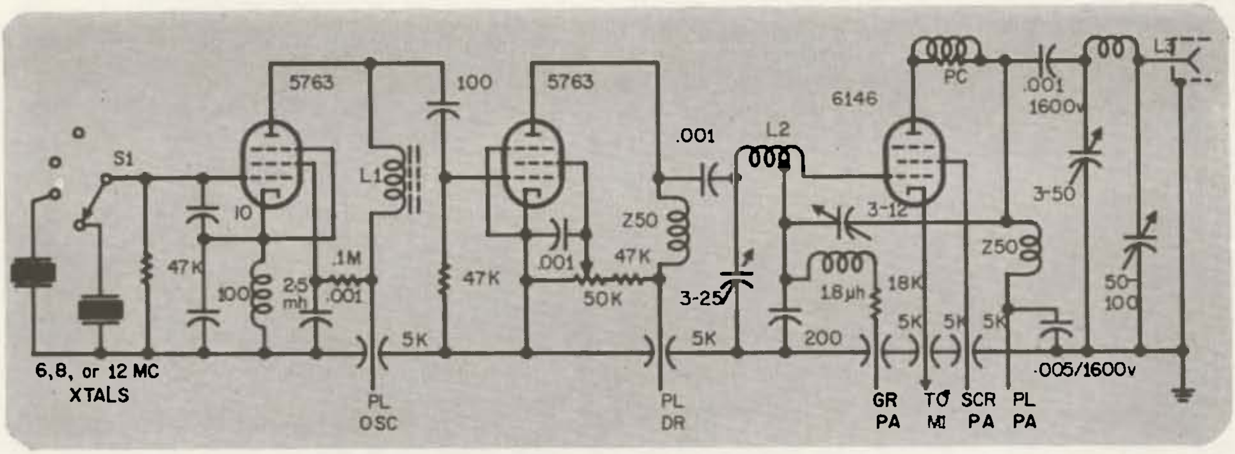


Fig. 4a.

back—using two separate rf sections with all switching being done in power leads, with only one power supply and modulator.

This box diagram led to the detailed schematic, Fig. 4. Actually, in the control circuit wiring the box is easier to follow.

With 6146's decided upon for the output stages, as determined earlier, tube choices boiled down to drivers. The tube books showed several would work, but 5763's were chosen since they had good characteristics throughout the frequency range and could provide a good safety factor of drive.

The modulator and power supply were left in box form, since a search of my library turned up already-published circuits for them which exactly fitted my needs.

The modulator is from the 1957 ARRL handbook, while the power supply is from Editors and Engineers Radio Handbook, 14th edition (later published in GE Ham News, vol. 12, no. 5.)

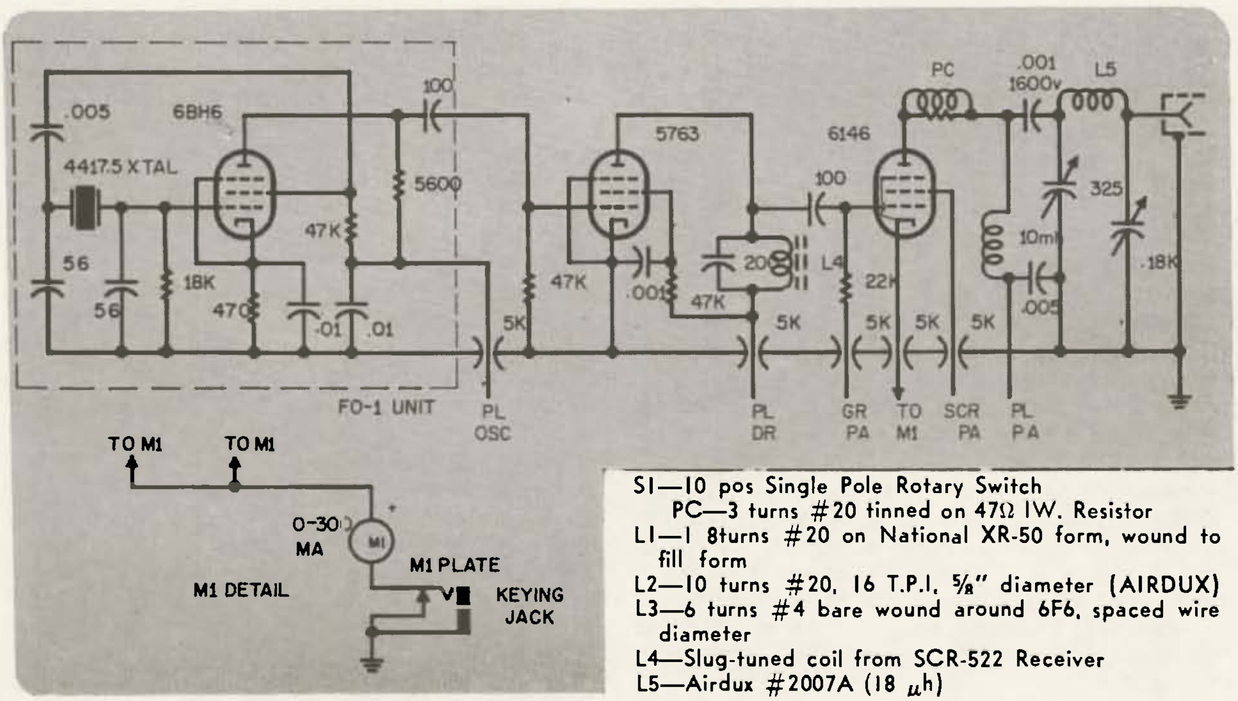
A couple of tips may help out in the business of putting all the component stages together on paper.

The first is the famous Fudge Factor, so ably dissected by another 73 author, John Campbell Jr., W2ZGU, in the pages of his own magazine. It basically consists of making allowances from theoretical data to fit the known situation, or in other words, make the closest thing you have available do to start with.

The second is this: mathematics formulas don't have to be difficult. Some of the handbooks fairly bristle with complicated-looking algebraic equations, apparently designed to scare away everyone except graduate engineers.

But if you take a close look, you can usually find a table somewhere nearby in which all the values have been worked out closely enough that the Fudge Factor can take over.

And as a last resort, you can always check published circuits until you find one similar,



S1—10 pos Single Pole Rotary Switch
PC—3 turns #20 tinned on 47Ω 1W. Resistor
L1—18turns #20 on National XR-50 form, wound to fill form
L2—10 turns #20, 16 T.P.I. 5/8" diameter (AIRDUX)
L3—6 turns #4 bare wound around 6F6, spaced wire diameter
L4—Slug-tuned coil from SCR-522 Receiver
L5—Airdux #2007A (18 μh)

and take the values shown there as starting points for cut and try work.

If you've been following directions closely to this point, the ream of paper you started with should be gone by now, and the dozen long, sharp pencils should now be worn and nubby stubs. All your acquaintances will be referring to you as "that fellow who's mumbling all the time," as well.

But cheer up. You're close to the culmination. Because you now have a semi-final schematic drawn for that rig you want.

One more step, and you're ready to dive for the junk box. That step is this. Take your schematic, study it carefully. You might even memorize it, if you haven't already done so. Make absolutely certain that it does what you want it to do—assuming it's going to work at all when you wire it up.

In all probability, you'll find several points you want to change. Make those changes, and draw a final working plan.

Now to the junk box. Everybody has a different approach to a building job, but I like to have every part, down to nuts, washers, and tie point lugs in hand before I start. I get them all together in a coffee can, then begins the real labor part of the operation.

You still don't need any fancy equipment at this stage, but of course, the more of it you have, the easier it can be.

The only absolutely necessary tools are a pair of wire-cutters, a hacksaw, a drill, and a soldering iron. The only piece of test equipment you can't get along without is a volt-ohm-milliameter of some sort, and this can be a jury-rigged affair.

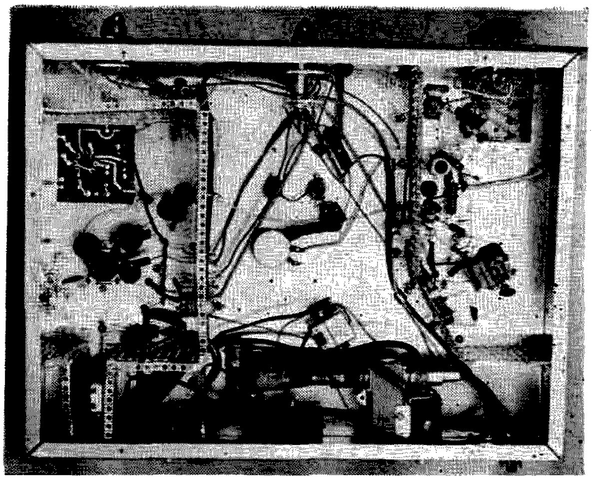
The ubiquitous grid-dipper comes in handy, sure, but you can build many a transmitter without one by careful calculation of coils.

At this point, parts layout comes into its own. If you're building a chasis from scratch, you can juggle the parts around until they're the way you want them and determine chassis size. If you're using a ready-made box, then shift the components on it until you're satisfied.

One point to remember, since it spells the difference between success and failure in many circuits, is to keep all signal-carrying leads short. Good looks of the panel may have to be sacrificed to attain this, but the object is to make the thing work.

Once satisfied with the parts arrangement, and with all parts on hand, you're ready to proceed with the wiring. Except, that is, for cutting the chassis. Drill all holes and mount all tube sockets and heavy items such as transformers. It helps if you turn tube sockets so that leads run naturally to the point they have to get to, rather than having to criss-cross above the socket.

Actual wiring is similar to wiring a kit, except that you have no instruction book telling you what to put where and when to solder.



Underside of chassis shows separation of RF sections. Clutter at rear of chassis is control circuity not shown on schematics. It includes antenna relays and receiver muting controls. Selenium rectifier provides DC for coax relay. Bandswitch assembly is at top center. Turned-over edges of shielding contact bottom plate firmly to button up rig against TVI. Also visible are ceramic feed-through capacitors used on all low-voltage power leads which pass through shielding.

I have found it most helpful to work from the first stage toward the rear of the equipment, completing each stage as I go and testing it. By this I mean start at the oscillator of a transmitter and work toward the antenna, and start at the antenna of a receiver.

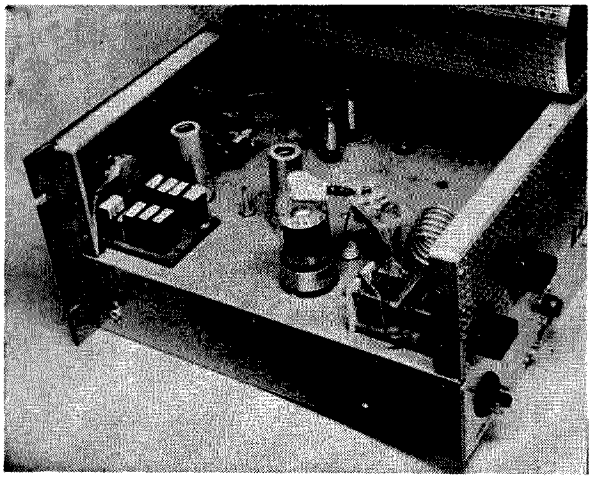
In original designs there is going to be much cut-and-try fitting, and sometimes things which look on paper as if they should work fine simply refuse to operate when you wire them up. Doing one stage at a time, building block fashion, helps you avoid trouble since you can test as you go along. You know as each stage is tested that it works, and if it fails you have more room in which to work on it.

If you wire your design in this manner, you'll know that it works when the last stage checks out. Next thing to do is to put it in operation.

Live with it a while. You can be sure of one thing: Bugs will appear. I have never heard of any equipment being built from an untested design working perfectly the first time around. Give the bugs a good chance to make themselves known.

Then, obviously, apply bug eliminator. This translates as hard work, since what cures a symptom in one rig only makes it worse in another. The handbooks, however, have good coverage on these troubles, and many suggestions.

After the first period of testing and improvement comes another, much the same. The second time, though, the troubles will be much more minor, and when they are cured, you



Details of 6-meter side of transmitter. Tubes in shields are 5763s. Behind them are two OB2 in low-voltage supply. Control behind OB2s is to set bias on final stages. Only one section of split-stator capacitor is used—but it happened to be in the junk box when rig was built

will have a piece of gear you can be proud of.

The final word is this: When it does what you set out to do, leave it alone! More bad signals are emitted from transmitters which were touched up just once too often than for any other single reason. Of course, this applies to all gear, not only homebrew.

Since you designed and built it you're naturally the most competent person alive to make improvements. But be certain, before you do, that what you're about to do is improvement.

You'll find, also, that the first time is the hardest. After that, the whole thing comes much easier, and before long, you'll have the reputation of being a man who can design anything anytime, anywhere, and have it work.

Since I used the combo rig here as an example earlier, here's the finished product, pictured in Fig. 5. Running 60 watts input to the final, high-level plate modulated, it has accounted for some 22 states and two countries on six meters despite a sharp lack of activity on my part, on the air. It gets 40 watts into the antenna, for 67 percent efficiency.

Most heartening of all, though, is the comment on it which is still music to my ears although I hear it frequently, on both VHF and MARS frequencies: "You can't be running 60 watts, old man. Your signal is the loudest on the band."

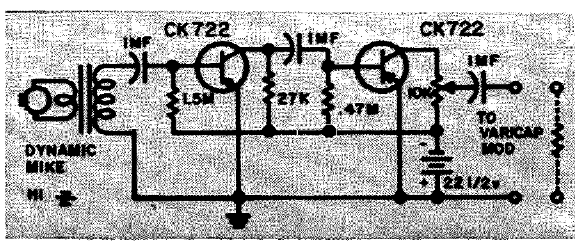
Excuse me now. I just had an idea. If you took a 4X-150A and a hetrodyne VFO. . . . . Gotta run for the slide rule. 73

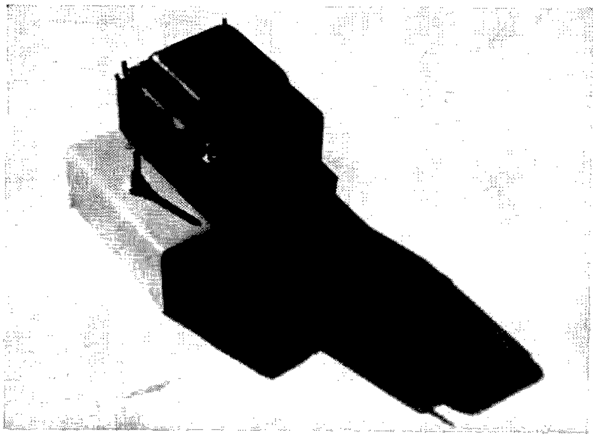
Pre-amp for Vaircap Modulator

THE writer has received several requests for the transistor pre-amp circuit used with the Varicap modulator. The original Varicap modulator was used in the VFO which multiplied from 10.5 mc to 21 mc and it was found that about 1 volt RMS was necessary to get a 3 kc band at the 21 mc transmitting frequency. A single transistor following a dynamic mike did this very well. Subsequently a 40 meter command transmitter has been modified by placing a Varicap modulator in the grid circuit of the oscillator. A VC-100 in series with a 25 mmfd ceramic were the only changes from the original circuit.

Using the above arrangement it was necessary to have over 2 volts of audio to get the necessary band width. So it was decided to build another pre-amp. After a little experimentation the circuit in Fig. 1. evolved. Battery and all is enclosed in an aluminum box. The mike has a standard phone plug screwed in the end and plugs into a standard jack on top of the pre-amp. This unit works equally well for 15 or 40 meters. The volume of course is decreased on 15. With NFM this will modulate 1 watt or 1 kilowatt equally well.

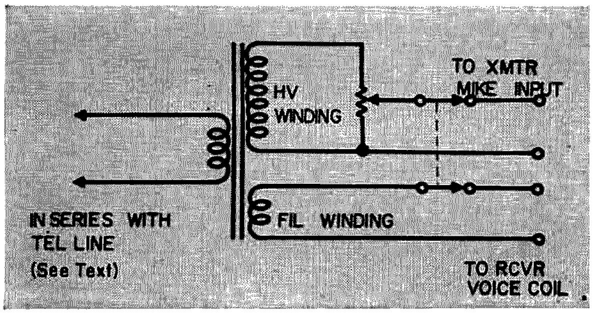
If 75 meter NFM is contemplated, perhaps a pair of 100 mmfd Varicaps in parallel, connected in series with a 40 or 50 mmfd mica or ceramic will do the job. . . . W7CSD





THE World's SIMPLEST PHONE PATCH

Jim Kyle, K5JKX/6
1851 Stamford Ave.
Santa Susana, Calif.



EVERY ham who aspires to perform any sort of public-service operating soon finds himself in need of a phone patch—and he then learns immediately that there are phone patches and more phone patches, all of them costing money.

The field of patches ranges from the fancy hybrid type (excellent for so many purposes, and the only kind which allows VOX operation on sideband) which bear an equally-fancy price tag, down to the well-known Macy Special which can be built for $2.98.

The subject of this article, though, outdoes them all in at least one respect—it will cost the average ham absolutely nothing! That's right, I said "Nothing!" Every component can be found in the junk box of anyone who's been in the business at least two months.

Required materials are these: one each discarded AC power transformer (the ancient 2.5-volt-filament-winding variety which can be salvaged from a discarded BC set is excellent), one each volume control (anything from 100 K upwards to 2 meg), a mounting board (the proverbial breadboard is fine), some wire, and a DPST switch. The switch is necessary only if you wish to be a mite fancier about it.

When you have these components gathered in your hot little hands, wire them together as shown in the schematic. None of the wiring is critical.

Operation of this patch divides into two phases—installation and use.

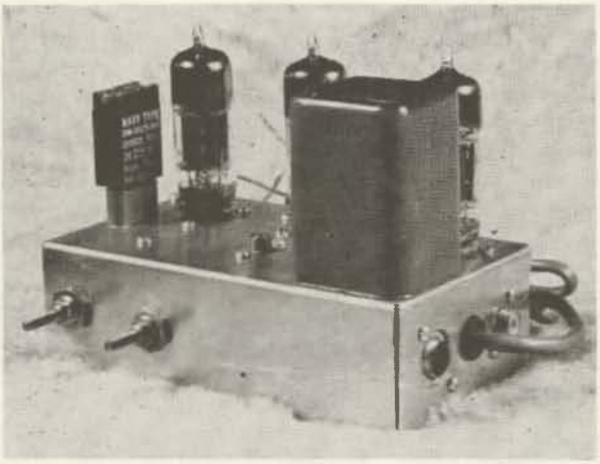
The patch is installed in what may appear to be an unconventional manner: Instead of being connected in parallel with the telephone line, it is connected in series with either the red or the green wire.

If the patch is inadvertently connected across the phone line, you'll hear from the telephone company, for it will create a continual busy signal on your circuit and make it impossible for anyone to call you. It will also hamper your placing of outgoing calls. Be certain to connect it in series to avoid this problem.

Once installed, the volume control may best be set by an on-the-air test with a couple of willing friends. Adjust this control so that the incoming telephone voice modulates your transmitter fully without splattering.

Volume of the sound fed into the phone line will be determined by the setting of your receiver's audio gain control. Try to keep it slightly below the volume of a normal telephone voice, to combat both the tendency of the telephone party to mumble and the tendency of the telephone line to create crosstalk.

That's it—the world's simplest phone patch. Have fun, and be certain you are ready to perform public service. 73



Ray Fulton K6BP
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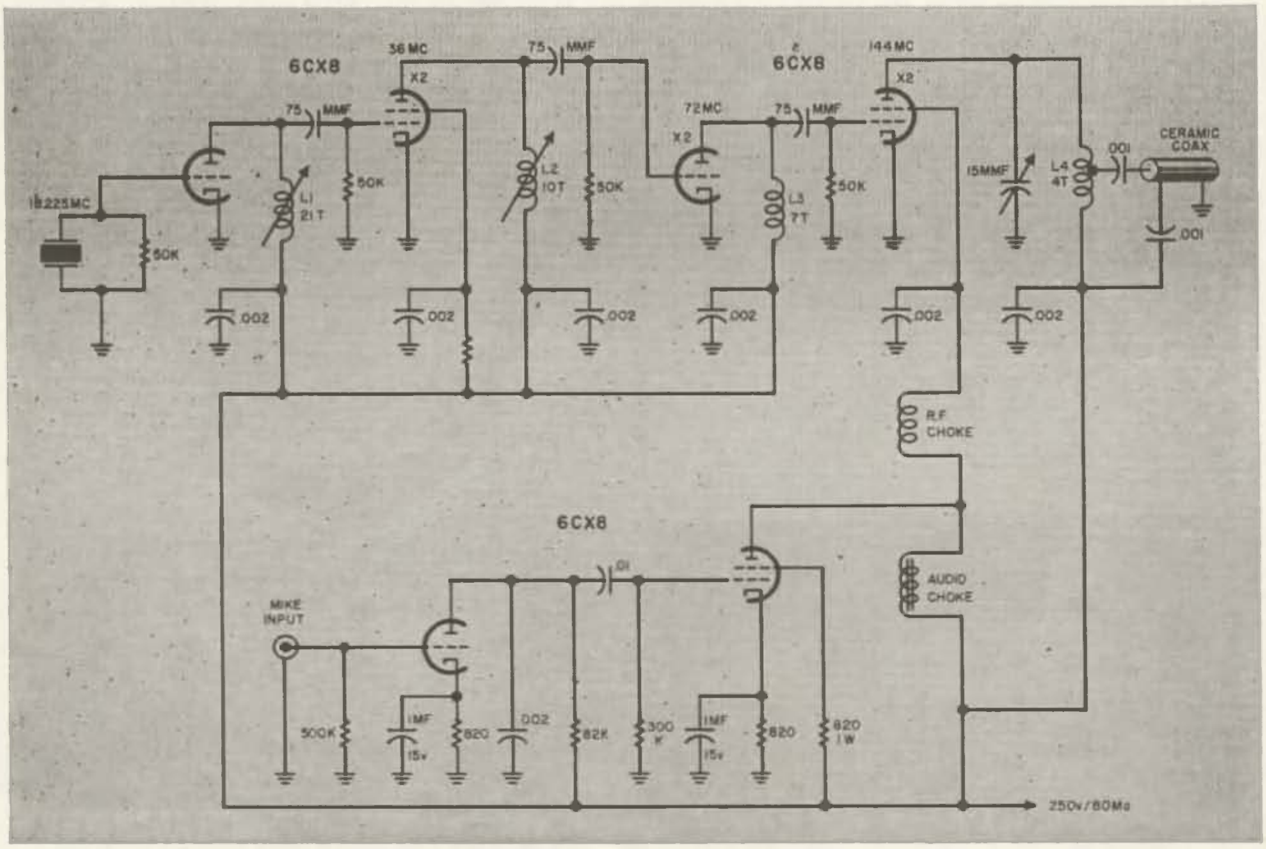
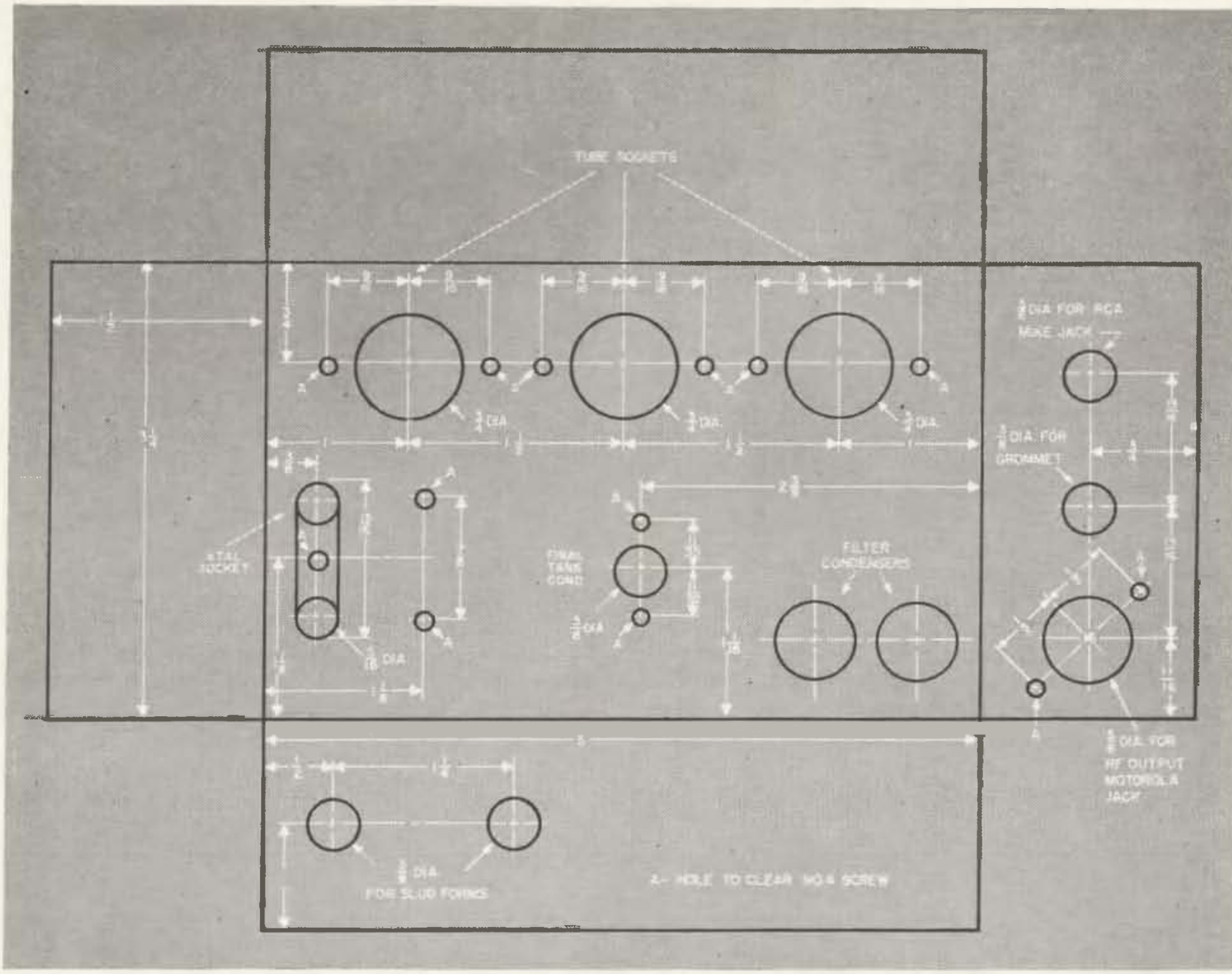
Lathrop, California

3 Tubes, 2 Watts, 2 Meters

IF ANYONE is running a contest for the simplest two meter rig I figure I have it won, hands down. Of course I had to pull a couple of "deals" to boil the rig down to such basics, as you will see, but the end result may justify the means. The finished product is a two meter phone rig that you can build in a couple of hours. Two watts won't work DX, but it will put you in good touch with all of the locals and generally that is all you need for rag chewing.

Short-cut number one was the use of an 18 mc crystal, which saves us an extra multiplier stage that we would normally use with





the more popular 8 mc crystals. Fortunately 19 mc crystals are available from surplus, so this isn't quite the hurdle that it might have been. These crystals come eight-to-the-box for just under $2. Three of them hit the two meter band, four hit six meters and one is fine for 220 mc.

The second short-cut is the Heising screen modulation. This really saves a lot of building and extra tubes. Not only that but it works just fine. Signal reports are quite flattering.

Construction

Those of you who are taking the first plunge at 144 mc type construction would do well to follow the layout diagram and photos rather closely. It takes experience to successfully ad lib. Your leads and by-passes have to be as short as possible. This rig has been built and re-built many times, so why not take advantage of all that spent effort and do it my way? Or maybe you'd rather rediscover all of the mistakes I've stumbled through.

The chassis is 5" x 3½" (or thereabouts). There are so few parts that you should have them mounted in a jiffy.

Schematic Diagram. L1— 21T insulated wire on 1/2" poly slug tuned form. L2— 10T insulated wire on 1/2" poly slug tuned form. L3— 7T 5/16" (lead pencil size) air wound #20 bare wire. L4 4T 5/16" air wound #20 tapped 1T from B+ end, bare wire. RFC— over 25T on 1/4" form or any small choke you have around. Audio Choke— primary of any small output transformer.

The Circuit

The triode section of the first 6CX8 is used as a crystal oscillator on 18 mc. This feeds into the pentode section where it is doubled to 36 mc. The triode section of the second 6CX8 again doubles, giving us 72 mc. We double again in the final to 144 mc, running about two watts input to the pentode section of the tube. Purists who are starting in with puttering fits at this point can calm themselves down somewhat . . . we recommend a small filter in the output to cut down the 72 mc output that might sneak through. Details on that later.

There is enough audio gain in this gadget to get all the sock you want with a crystal microphone.

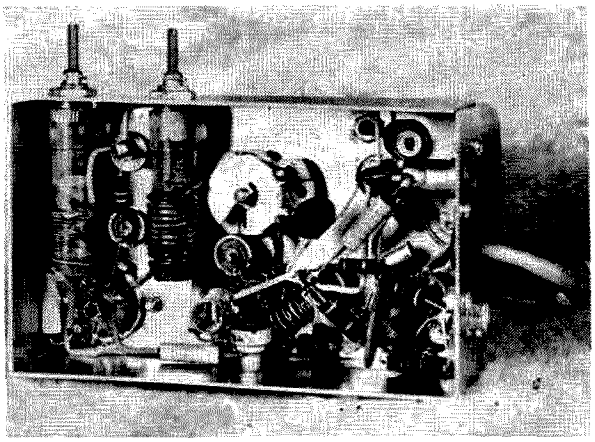
Details

Grid dip your coils to be sure they cover the range desired. You can save an awful lot of time and frustration this way. When you are ready to tune up the rig it is a good idea to limit the voltage to 150 v so the tubes can't be damaged. Tune the oscillator, then the 36 mc stage. The 72 mc stage has to be tuned by squeezing the coil. A field strength meter comes in handy about this time. A voltmeter will do a lot too. Ground the positive probe and connect the negative probe through an rf choke to the grid of the stage following the one you're tuning. This will measure the drive to the following stage.

If you are impatient with a fixed frequency rig you can grid dip yourself a slug tuned circuit for the 72 mc stage.

Now, about that trap to remove you from any 72 mc receivers in the immediate neighborhood. Ten turns of #20 (or so) on a half inch form with a small variable condenser (15 mmfd) in series with the coil should be connected from the antenna terminal to ground. This can be built into the rig. Dip it to frequency.

Oh, and about those extra crystals you got



back in paragraph two. This rig can be reworked for six meters quite simply, as you should suspect. It will also perk on 220 mc, which should come as a surprise. Try a three turn 3/16" diameter #20 bare wire coil for the "tank." Connect antenna one turn from B-plus. Use the dipper carefully on this as there are all sorts of frequencies you can be using with this arrangement. You will only get about a half watt, but you'll be on 220!

Have Fun

. . . K6BP

SQUAWK!

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Now that we are irrevocably into 1961 and our New Year resolutions have been thoughtfully filed away, let's turn from seasonal self-appraisal and consider the mischief perpetrated by other people.

It seems strange that fair-minded, tactful and unbiased criticism usually meets with resentment. It shouldn't—such criticism is mild, benign and useless. On the other hand, the effective critic is biased by personal experience, single-minded and happy to sacrifice the grace of tact for immediate results. He meets opposition head-on, wins or loses without wasting time on irrelevancies and moves on to another issue. But his blunt arguments shouldn't be resented either for there follow upon such efforts all the progress we make which cannot be laid to fortuitous chance. (What other ham magazine prints phrases like "fortuitous chance"?) (It's redundant, but sort of Churchillian.)

We have our marvels of transportation and communication because us here-now common folks weren't satisfied with running and shout-

ing as transcendent activities. We were critics who wanted something better than we had.

In this economy the best inspiration of the inventor is the potential consumer standing behind him—waiting. So they tell us, and if it's true I'd like a second chance with some of those resourceful gentlemen. For example, I wouldn't waste much time if I could get into the right position behind the one who thought of marking miniature, G and GT tubes with vanishing ink, sea water or fairy tears. Whatever the stuff is I have come to suspect it begins fading on the date of sale.

It is true that if the internal structure is visible an experienced prospector for markings can often confidently hazard a guess as to the tube type, but hazard is unfortunately the right word and in this sporting spirit you can even try a tube tester to confirm or refute your insight. Also ingenious schemes for deciphering faint identification marks have been published in our magazines, but these experiments with oblique illumination, ammonia or polarized moonlight fail with me. They end as they begin—with my crossed, myopic eyes trying to focus on a tube pressed against my nose. Revolted by frustration, my brain, which is not very large or healthy anyway, slips out of gear into a neutral state which is manifested as daydreaming. This is hilarious to my children who promptly press tubes to their hot little noses and invent a typical "family fun" game combining apparent lunacy, aspects of hysteria and sly deflation of a grown-up.

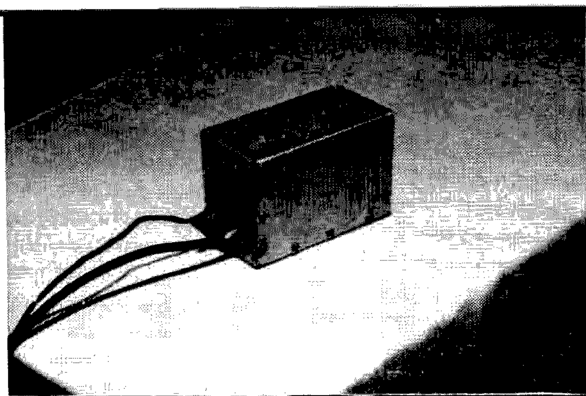
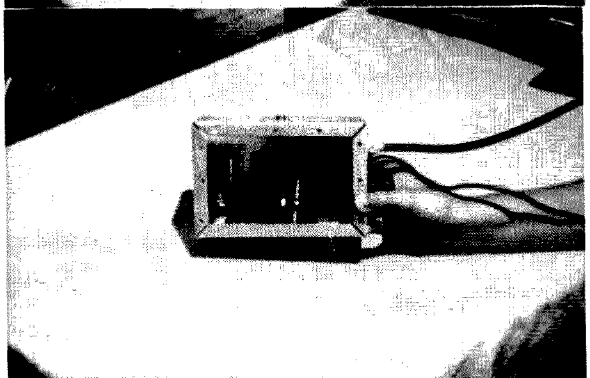
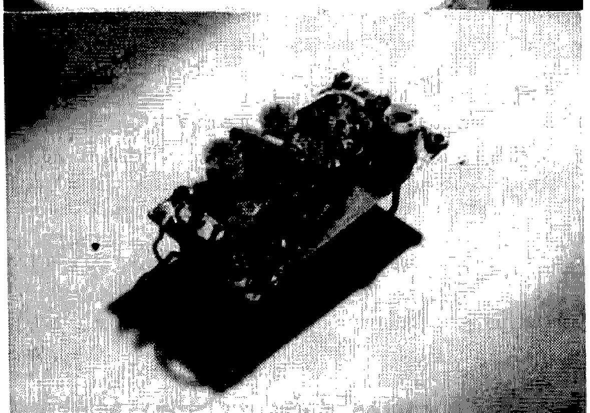
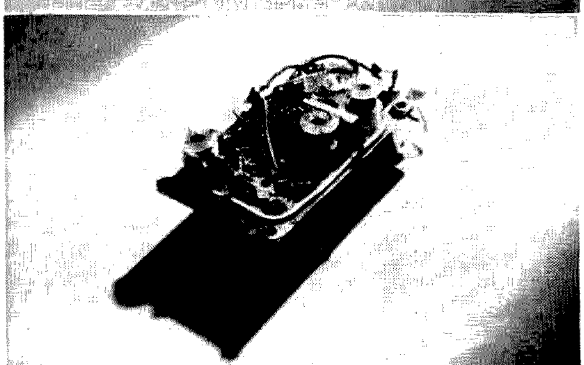
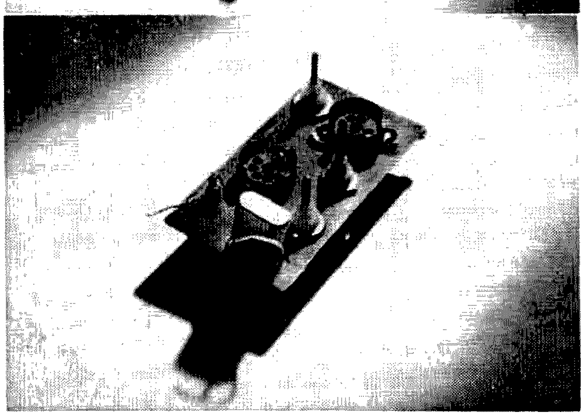
So many glass octal tubes had their identification stamped handsomely on the base as well as the bulb during the second World War that this security leak came to be taken for granted. Presumably that novel concession was made to facilitate turning the stubs in for replacement in the event a direct mortar hit broke the glass. Anyway the favor was soon withdrawn. Came peace, back to the modern evanescent message on the bulb, and on the base nothing but a fancy trademark and mysterious code numbers which are probably digital for "lots of luck," or something worse.

In the late forties I was living in a low-noise, high-DX area of western Alaska when one day a shipment of tubes furnished me with short-lived encouragement. These were standard types of octals but with king-size markings on the bases as well as on coated bulbs sized between G and GT. They looked very businesslike. I plugged one into my VFO and went out of business. This was the pre-war Millen ac-dc model and the difficulty was that the heater current requirements of the tubes bore no relation to any figures in the tube manual. Later someone told me that they had been manufactured to special order for the British forces, perhaps with the idea that if you shoot a private calibre the enemy can't use your ammunition. Maybe this was a blow to the Nazi table radio Gesellschaft, certainly it was a blow to me for tubes were hard for me to get and I suppose it contributed to my moodiness about their markings.

It would seem to be less than charitable to address this pipsqueak of a complaint to the industry that provided me with, among other blessings, a lively 6D6 I have had for nearly a quarter of a century, vintage 80's that would pro-rate at a nickel a year, 6C5's whose life span may exceed mine, and so on. Yet there are indications that a a few obstreperous growls from the market place would not be untimely just now. The increasing sheet-metal elegance in much new equipment, the airy references in copy to "dial excursions" meaning tuning, the endless abuse of "mode" and "configuration" and other annoyances lead me to suspect that some of our manufacturers whose products have deservedly been accepted on faith may be putting too little emphasis on the qualities that made them successful. Land sakes, I hope our tube and equipment producers aren't in danger of infection by the wrap-around tail-fin crowd.

We have been fortunate in that the major manufacturers of the gear we use profess and demonstrate a stringent honesty in their dealings with us, indeed to the point of crustiness if the quality of their effort is questioned. Some years back, to illustrate just for fun, I bought a small transmitter from McMurdo Silver and found occasion to write to them regarding the possibility of parasitics. A swift reply combining equal parts of courteous advice and snappishness somehow left me with the feeling that I was on probation as a customer and should cherish my good fortune carefully. I'm sorry to say that I can no longer find this letter, but I do have one from Barker and Williamsom which illustrates the same point. I wrote to them to order a variable condenser for a dip meter which has given fine service for ten years. They answered promptly, coolly advising me that it would be quite pointless to sell me a new condenser because the units do not become defective, and they added pointedly that they had never had any complaint about them. (Who's complaining?) If I cared to return the dip meter to the factory, however, they would restore it to new condition. I knew I could bet my bottom socket it would come back to me with the original tuning condenser in perfect condition, and as I'm as hardheaded as the next guy I didn't send it. I was careful to keep the letter, and I may have filed it under "Soreheads" but I like it. It spells pride to me.

Okay, fellas—shoot the works on high style cabinets, continue to print the values on some micas and color-code the ones I need, micro-engrave the ends of cartridge fuses, don't give in on standardization of transistor designations, but how about those markings on the GT's and miniatures? Use the good stuff you put in the trademarks. . . . W7IDF

50 Mc Converter Without B+

Jim Kyle, K5JKX/6

By now it's no secret that mobile operation with the new hybrid and transistorized auto radios is possible. Either transistors or the 12-volt series of vacuum tubes can be used in a ham-band converter with these sets.

However, this trick has apparently been employed only on the lower ham bands. No circuits for VHF converters for use with high-voltage-less auto radios have been published to the author's knowledge.

Here's one for the 50 mc band which gives excellent results in local-range work. While its sensitivity won't measure up to your cascode-amplifier home-station converter, it will pull in any signal you can ever read under mobile conditions.

The tubes used were carefully selected from the entire 12-volt series for maximum transconductance. As a result, the receiver with this converter will give a clear, readable output with less than 1 microvolt input.

Basic operating principles of the circuit are similar to a conventional converter. Incoming signals are amplified by the pentode rf stage and mixed with the local-oscillator 49.4 mc signal in the converter. Output, in the 600-4600 kc range, is taken from the converter plate.

When used with a conventional auto receiver the converter tunes from 49.95 to 50.95 mc. Since the lower 100 kc of the band has been assigned for CW exclusively, you might want to change the crystal to a 49.55 mc unit and tune from 50.1 to 51.1 mc. Tuning is accomplished with the auto radio tuning knob.

Only two differences exist between circuitry of this converter and a conventional unit using high-voltage type tubes. The most obvious is in the grid circuits. Since cathode bias would rob you of a large portion of the plate supply voltage, contact bias is obtained through the

2.2 megohm resistors. Signal is coupled to the grid through low-value capacitors.

The other difference is the absence of any screen-dropping resistors. With 12-volt tubes the screens take full plate supply voltage.

Not shown on the schematic, since it may not be necessary in all cases, is a low-pass filter in the 12-volt supply line. The filter, which resembles a conventional power-supply filter in arrangement, removes all noise from the battery line and assures that only pure dc reaches the converter tubes. It was added to the prototype to eliminate vibrator noise from another unit.

The converter is built on a plate of flashing copper, 2¼ by 3½ inches in size. Brass 6-32 nuts soldered to the plate at the corners allow for mounting with 1½ inch spacers in a 3 by 4 by 5 chassis. The open side of the chassis is covered by a sheet of Reynolds do-it-yourself aluminum held down with self-tapping screws. These elaborate enclosure methods were employed to keep all noise possible out of the converter and to assure that any signal reaching it would enter through the antenna jack only.

The copper chassis is easily soldered with a 47-watt "super-hi-temp" tip in an Ungar soldering pencil. All tube sockets and tie points were soldered instead of bolted to the plate.

Coils L1, L2, and L3 were obtained in surplus. Their nomenclature and value are unknown, but any coil of proper inductance and Q will substitute. The coils were purchased ready-wound, and required only the removal of three turns from each to fit the converter's requirements.

The switch, visible in the photos and shown on the schematic, is another surplus item. A 4PDT bat-handle toggle, it provides single-control operation for the converter. Input and output connections are made through standard auto-radio connectors, and a 3-foot extension cable (NOT regular coax) is used to connect the converter to the auto radio.

Few parts values are critical in this converter. However, converter-plate-circuit components (the 1 mh rf choke and the 68 mmfd capacitor) should not be changed. With these values, and the 3-foot length of auto-radio antenna cable, the circuit is broadly resonant at approximately 1 mc and gives good output across the broadcast band while discriminating against higher-frequency noise in the neighborhood of 3 mc.

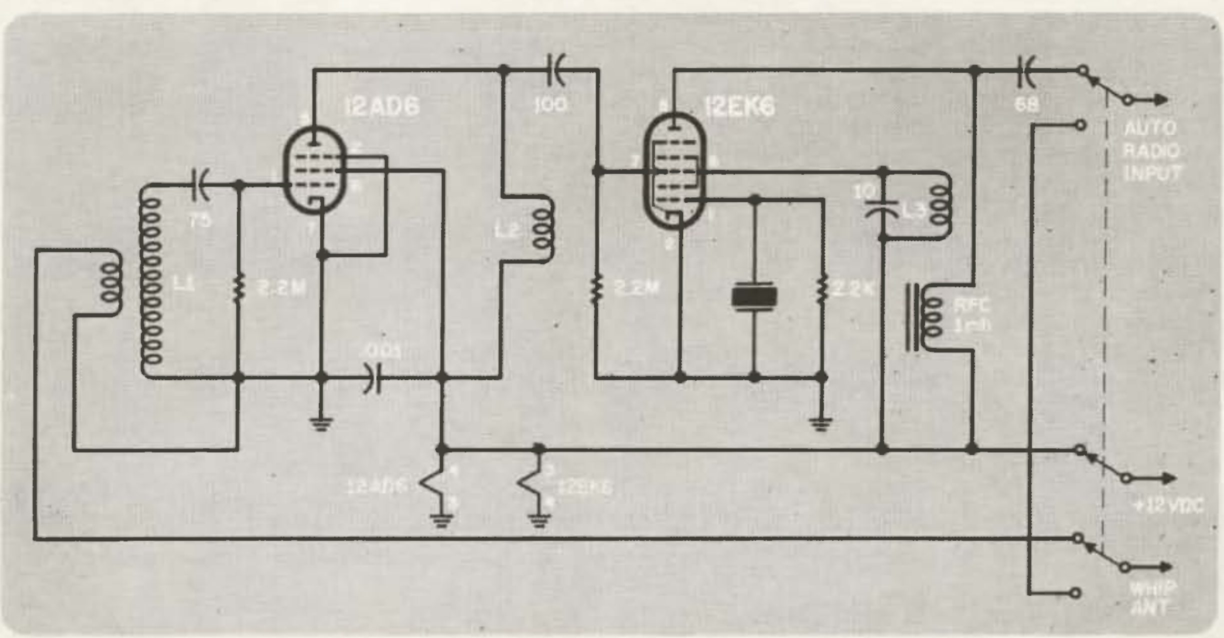
Another item which will have quite an effect on converter sensitivity is the 22,000-ohm crystal resistor. This may be varied from the value shown up to 470,000 ohms. However, local-oscillator amplitude will vary as this resistor is changed, and may reduce the converter's gain. The value shown was best for the prototype—other converters might require a different value.

Using the layout and components shown in the photos, the finished converter is a natural for hideaway mounting. One of the original design specifications was that the unit be mounted completely concealed behind the dash lip on a 1959 Ford, with the on-off switch readily accessible but not visible. With this added feature, you should have no XYL trouble with this converter. 73

L_1, L_2, L_3—8 turns No. 24 enam on 3/8" nylon iron-slug form (surplus item—dip to frequency)

L_1 link—3 turns hookup wire on top of L_1

Crystal—49.4 mc. overtone (International FA-5)



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Rochester 20, N. Y.

The Heathkit Hybrid Phone Patch

. . . a review

FROM a fundamental viewpoint a phone patch unit has a formidable set of conditions to satisfy. It must match the nominal 600-ohm balanced landline to the unbalanced high impedance input of the transmitter, and it must match the very low impedance speaker line (3 to 8-ohms usually) to the same line. It must do this using one line for both transmitting and receiving *without switching*. And finally, is must maintain isolation between the speaker and microphone so that a feedback loop is not formed. In view of these considerations, a good phone patch is a pretty neat trick.

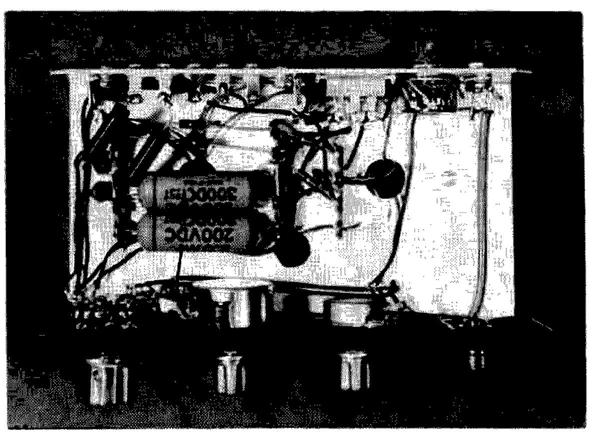
Fortunately, a traditional technique of the telephone industry is perfectly suitable to the problem. This is the hybrid matching method used in most phone patch designs. In essence, transformers are utilized with their windings wired into a bridge circuit in such a fashion that signals coming in on the phone line will appear at one set of transformer windings (connected to the transmitter input.) Signals coming into another set of windings from the receiver will appear across the land line terminals while cancelling out in the winding connected to the transmitter. And, since transformers are used as the coupling devices, impedance transformations can be accomplished at the same time.

There have been many phone patch circuits described in the literature around adaptations of transformers which were available in surplus or which were made for other purposes. Most of these have been compromises in that the transformers didn't always exactly fit the requirements. Many of the circuits did not provide for matching to land line which were somewhere between balanced and unbalanced electrically (as many phone lines are), and they did not provide for a method of monitoring and adjusting the level of the signals to and from the line.

Troubles with many such home-brew phone patches have generally taken the form of: high hum level making intelligibility poor and VOX operation difficult if not impossible; overdriven phone lines causing cross-talk in the telephone company's equipment; and generally poor audio quality as a result of the use of transformers not specifically designed for the purpose. The fundamental problems of adequate isolation between input and output and of prevention of rf energy from feeding into the telephone system have also been inadequately solved by some of the earlier designs.

Fortunately, the Heath Company with its usual competent engineering has solved all of these problems in the Heathkit Model HD-19 Phone Patch. Due to the size of their market, they could have good quality transformers made up to suit the application. Provision is made for balancing the bridge of the phone patch to imperfectly balanced land lines; and a VU meter is provided for monitoring the line at all times to assure that it is not overdriven. (The meter of the VU circuit also serves as a very sensitive and effective indicator for making the line match.)

Two potentiometers on the front panel allow adjustment of transmitted and received signals to comfortable levels while another potentiometer on the rear apron adjusts the balance of the patch to that of the line. Two switches complete the external controls available. A slide switch on the back apron places the VU meter across the line for monitoring purposes or the meter at full sensitivity across



the microphone output of the patch for balancing purposes.

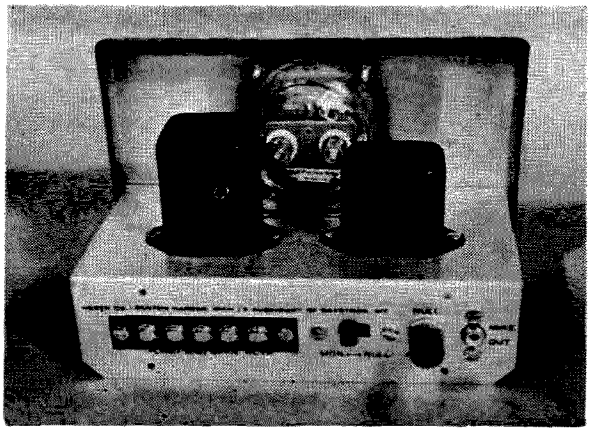
The front panel switch places the patch in or out of the circuit as desired. It provides for switching the microphone straight through to the transmitter and the receiver straight through to its speaker when the patch is off. In the "on" position of this switch, the speaker and microphone are both disconnected and local input and output of the station are through the telephone handset only. This switching arrangement allows the patch unit to remain connected at all times without affecting normal operation of the station.

A terminal strip, coaxial phono-type output connector, and a coaxial microphone connector complete the connectors supplied. Shielded cable and mating connectors are provided for making up the line from the patch to the transmitter microphone input.

Underneath the chassis are the components of the line filter which prevents rf from being fed into the telephone lines, and the two 2-mfd. capacitors which are paralleled to form the dc blocking, audio-pass filter between the patch and land line.

Construction time for the kit is about two hours at the most for a careful worker, and there is nothing tight or tricky about it.

All of the external connections are spelled out in good detail in the manual. However, there is one thing which must be watched here, and which is not mentioned in the manual. Many modern communications receivers have one side of the output transformer secondary grounded to the chassis of the receiver. This polarity must be observed in connection of the receiver to the patch, or it will be found that the speaker is "on" under all circumstances and cannot be switched by the patch. Since the dc resistance of the output transformer is quite low, it is not possible with the usual types of ohmmeters to determine which of the terminals is grounded in the receiver. You must either find this from the schematic in your receiver's manual, or as a last resort you will have to open your receiver and see which terminal is grounded. (Of course, you can try the connection one way and if it



doesn't work, reverse the lead connections at the patch. But this is a most unscientific way to proceed!)

Connection of the patch to the land line can be made with almost any kind of insulated wire—zip cord, twisted pair, etc. Since this is a low impedance balanced line, there *should* be no rf pickup. However, if you want to be sure, and especially if the line must run in close proximity to your transmitter, you can use two conductor shielded line (not coaxial) such as is sold for running shielded extension speaker leads. Ground the shield of this line to the patch and leave the other end floating.

There are only two criticisms which the writer has after a few months use of this patch. These are:

It might be better if the null adjustment potentiometer and the meter switch had been placed on the front panel. Admittedly, these need not be used often; but when it is necessary, it is a nuisance to have to pull the patch unit out to gain access to them. And, in those stations where each piece of gear is built into its own pigeon hole in a console, this could be a great annoyance.

The other criticism is a very petty one indeed, but one which could be easily corrected. The metal knobs are very neat in appearance and should be quite serviceable, but the index mark on the two small ones consists of a very small indented triangle filled with red paint on the narrow skirt of the knobs. This is quite difficult to see from the usual operating position distance. A dab of red paint on the side of the knobs has solved the problem for the writer, even though it doesn't look very professional.

In summary, the Heathkit Phone Patch is a very satisfactory piece of gear, and one which we can hope will attract many operators into providing themselves with patching facilities. This activity is one of the most rewarding in amateur radio, and one which certainly is good public relations for our hobby. The gratitude of some of the people who can hear the voices of their loved ones from overseas is heartwarming, and this is often their first personal contact with amateur radio. **73**

Life Insurance for Your Transistors

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GENERAL purpose transistors of both low power and high power are becoming to be extremely inexpensive. RF transistors for Amateur frequencies through the VHF range are even quite reasonable. However, this does not necessarily mean that the transistor—or other semiconductor we are using—will have a readily available replacement. Many experimenters and technicians (and engineers) tend to grow a bit careless in the use and handling of transistors. The result is of course a rash of casualties which could be avoided by following a few common sense rules in the application and use of the semiconductors, which normally should have an extremely long life span.

Soldering

Practically all articles written on the construction of transistor circuits recommend the use of long nose pliers as a heat sink. Very few, unfortunately, tell how this can be done. There are two fairly easy and convenient methods. (1). Hold the pliers in one hand, the soldering iron in the other, and hold the solder between your teeth. This is not particularly recommended for people who are susceptible to lead poisoning. (2). The transistor lead and the lug or terminal are both pretinned, then a bit of solder on the iron is applied carefully and quickly. My preferred method of heat-sinking the lead is to use a small Mueller coil clip, (type 88), or a flattened copper Minigator clip. Effectiveness of the heat sink can be checked by measuring IcO while soldering.

The type and wattage of the iron itself makes a lot of difference. A big iron can actually radiate enough heat to ruin a diode or transistor even though the connection being worked on is not even electrically related to the semiconductor. A very low wattage or improperly tinned iron, on the other hand, may take so long to solder a connection that heat has time to travel up the leads and ruin a transistor in spite of the use of a heat sink. Some irons are not sufficiently isolated from the line to prevent a slight surge of current on contact with the transistor lead. For work with VHF transistors an isolation transformer of some kind on the iron is highly recommended.

Most germanium transistors have iron leads. This aids in slowing down heat conduction to the extent that a temperature of 240 degrees C is permitted for 10 seconds as close as 1/16 inch ± 1/32 inch from the base. Obviously there is no room here for a heat sink of the usual type. A little spacer is available from some manufacturers to lift the transistor off a printed circuit board to provide a slight safety factor when dip soldering. Inexpensive silicon diodes have copper leads. This should not be overlooked when soldering them into a circuit with very short leads. The higher temperature rating of silicon can be easily exceeded with a good hot iron. Fortunately perhaps, Zener diodes commonly are equipped with iron leads, and in addition the Zener breakdown point is not nearly as sensitive to temperature as is IcO in transistors. That is, Zener diodes may recover, but transistors seldom do.

To avoid soldering the transistors into the circuit, many wise experimenters use sockets, especially in their breadboard circuits. A curious note is that this too has it's pitfalls. A transistor can easily be spoiled if you solder to the socket while it is plugged in. In addition, one text says that the junction may be fractured unless precautions are taken when clipping the leads with a sharp pair of cutters. Ever consider how fast and far the clipped lead flies across the room? The old saying "for every action there is an equal and opposite reaction" may well be applied here. Of course some types of transistors have already been tested for shock resistance. One common test is 3 drops from a height of 30 inches to a maple block. Another is a vibrational test of 500 G's. After purchasing a transistor for a particular circuit it is wiser to avoid any similar tests.

Test It Before Use

While any new piece of gear or component thereof is generally considered to meet specifications, in semiconductor work these specifications are often quite liberal. For example, CK722's have been encountered with IcO of 10 microamperes and Beta of 20, and also with IcO of 1 microamp and Beta of 200. Both might be considered as good for some circuits, but not for others. The breakdown voltage rating is also very important in certain circuits. Fortunately again, most are rated far below what they can really take. In particular, the emitter-to-base breakdown voltage may be several times what the spec sheet indicates as a minimum value.

An example of where these ratings should be considered is in a free running multivibrator circuit. Here the low Beta units may perform better than higher gain transistors. Also, the base-to-collector junction is subjected to twice the power supply voltage when the base is reverse biased by the charge on the coupling capacitor. Hence, with a 22½ volt supply the junction is subjected to 45 volts. This is a mite high for popular experimental types, and the 22½ volts reverse bias on the base-to-emitter junction is too high for even more expensive industrial types. This, coupled with the increase of IcO at such voltages, leads to the necessity for selection of each one. While selection can be made easy if you build up a test circuit, the need for replacement at an inconvenient time (middle of DX QSO) should be considered.

Protection

Transistors and diodes can extinguish themselves much faster than any known fuse of similar ratings. This naturally leads to the obvious conclusion that it is useless to attempt to fuse your transistor circuits. Thanks to the happy circumstance that power transistors are becoming inexpensive, this is not too much of a problem. But a power transistor *can* be protected with a fuse, provided it has a high peak current rating and a series resistor is used to limit current to this peak rating. Here again this is a partial truth, in that a short circuit will blow the fuse, but a slight overload may catch an occasional transistor first. In any case, if the transistor is rated at 10 or 15 amps peak current, a Littlefuse type 8AG fuse of 1 or 2 amps rating is often very helpful.

Additional protection for power transistors can be provided by careful design of the circuit, avoiding possibilities of generating high transient peaks in case of overload signals or amplifier tests using square waves, etc. Sharp inverse spikes, such as the kickback voltage from a relay, may not immediately ruin the transistor since even if it breaks down the current is limited by the circuit resistance. Since these circuits generally reverse bias the base-emitter junction to cut off collector current and thus open the relay, the collector to emitter current during breakdown may be concentrated in a very small area of the junction. Eventual malfunction is almost a certainty, due to an accumulative effect of this.

In using power transistors to really handle lots of power, or where temperature derating is necessary, the manufacturers spec sheet should be examined very carefully. Rather than trying to economize on the size of the heat radiator used it is advisable to make it larger than recommended. This will help make up for the fact that you didn't have the right type of silicone coating for the assembly, and the slight errors in calculations that always seem to creep into experimental work. Many larger manufacturers have free bulletins on how to handle the problems with a minimum of risk of error and effort.

Don't Panic

When a transistor accidently pops two conflicting emotions occur. One is the feeling of dispair—what to do next. The other is the temptation to say "it was an accidental short," and plug in or try another one. That type of procedure invariably results in one or two more "popped" transistors. These are occasionally useful as diodes, but that doesn't help solve the problem. If a careful check of connections reveals nothing wrong it is possible to calculate the value of two or three resistors to temporarily replace the transistor and make voltage measurements, unless the transistor was expected to furnish self-bias as in some oscillators. The open circuit voltages with the transistor disconnected may also give some clue as to what went wrong.

Interpreting the Ratings

This is really a tough problem if you take them seriously. As a matter of fact many transistor ratings on the usual spec sheet do not really mean much to the radio amateur except to serve as a guide in selecting the type to use. Once you have definitely decided on a certain type for a particular circuit, it still is quite as important, to test this transistor to be sure it will work. Returning defective transistors to your local jobber may also prove to be more of a task than was the case with vacuum tubes.

The best solution is to test your own as you buy them. Several portable transistor and diode checkers are on the market, and many have been described in construction articles. The main point of this is of course to get the best your dealer has for the circuit you are planning to use. If he recommends another that he has on hand you should be able to test it and make your own decision. Naturally his friendship and cooperation are very important; both of which are more likely to be found on lax week days than on a busy Saturday morning.

Last But Not Least

While a common (and sometimes justified) comment of confirmed vacuum tube type personnel is that "transistors aren't here to stay," the fact remains that transistors will stay around a very long while if they are treated with the respect they deserve. They have innumerable advantages over tubes or other types of amplifiers in certain applications, and they can certainly give you your moneys worth of trouble free operation with a lower casuality rate than you may have learned to expect. 73

Staff

BEAT GENERATION

NOT too many years ago, CW reception was a simple affair. You either adjusted the one-lunger until it broke into oscillation, or turned on the BFO—and that was all there was to it (except the small matter of copying the code).

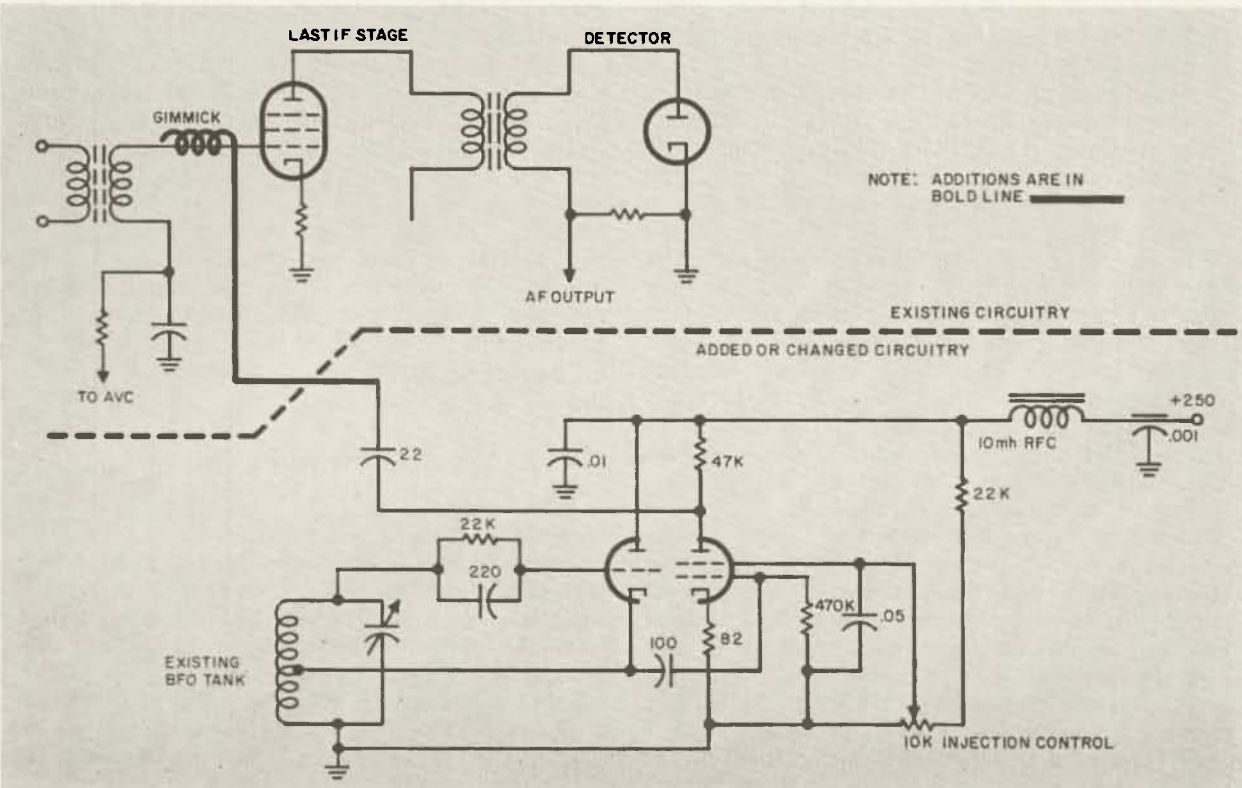
In those ancient days, sideband hadn't been heard of by most of the ham fraternity—and reinserted carrier detection was just a group of almost-meaningless words.

Not so any more. With the rise of SSB operation and the similarity between SSB and CW detection techniques, the business of demodulating a carrierless (or interrupted-carrier) signal has gotten complicated. A whole group of new detection circuits has been developed.

Interest in these circuits has gone through a sharp peak in the past few years, leaving a mass of misinformation in its wake. Pros and cons of each circuit have been aired quite thoroughly—leaving most of us slightly befuddled if we try to answer the question, "Which is the best technique?"

The purpose of this article is to gather in one convenient location most of these circuits. together with a listing of the advantages and disadvantages of each. With this information, you can easily determine which—if any—will do the most for beat generation in your own set.

Fig. 1—Conversion of the BFO to an adjustable-injection circuit allows foolproof SSB and CW reception. BFO components and all power leads must be rf-tight to prevent leakage of energy and subsequent birdies. The "gimmick" shown at if grid consists of two or three turns of insulated wire wrapped around the grid lead.



The major purpose of any SSB or CW detector is to mix locally produced signals with the incoming rf, thus generating beat notes in the audio-frequency range. In the case of CW, the beat note has a steady frequency. With SSB input, the beat varies in both pitch and amplitude, reproducing the original voice.

Of course, any non-linear device will cause a mixing together of input signals. In hi-fi, they call this intermodulation. In receiver front ends, it's called cross-modulation. In both locations, it's an evil byproduct of improper operation.

A better diode detector for reception of SSB is the "square-law" detector. With this one, output is proportional to the square of the input voltage. On AM, distortion is high, but the distortion is of such a nature that it tends to correct some of the diode's deficiencies for SSB use.

There's no particular trick to installing a square-law detector in your set, since the conventional diode action becomes square-law at extremely low signal levels. Just turn the AF gain up full and the RF gain down low. . . . Sound familiar?

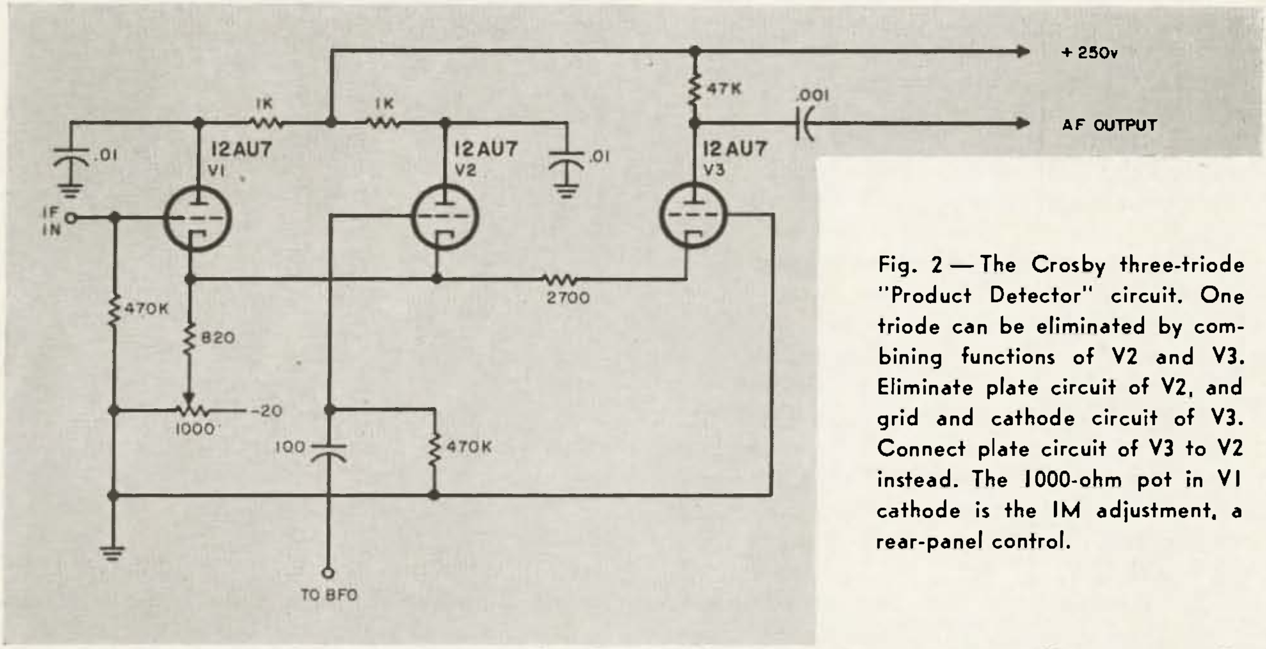


Fig. 2 — The Crosby three-triode "Product Detector" circuit. One triode can be eliminated by combining functions of V2 and V3. Eliminate plate circuit of V2, and grid and cathode circuit of V3. Connect plate circuit of V3 to V2 instead. The 1000-ohm pot in V1 cathode is the IM adjustment, a rear-panel control.

But in reception of SSB or CW signals, it's a necessity to produce results. That's rule one —the detector must be non-linear.

So what's all this we read about "linear SSB detectors" in advertising, product reports, and some theory articles? What the writers really mean is this: the detector isn't linear in its own operation, but it produces a signal which is related in a linear manner to the original modulation.

The same confusion is present in AM detectors. They, too, must be non-linear to give results—but the most common type is called the "peak linear" detector.

That's just the beginning of the confusion, though. The peak linear detector, which is inherently non-linear in itself, doesn't even give linear reproduction of SSB or CW signals in most cases. While the input frequencies are mixed properly, the output is of almost constant amplitude. This destroys all naturalness in the received signal, and in fact makes it undecipherable. You might say it's overmodulated—the sound is the same.

Of course, distortion is still present with this arrangement — although some extremely pleasant-sounding SSB can be received in this manner. The major cause of the distortion is our old friend the square-law characteristic. If we could operate the detector in peak-linear fashion but escape the automatic amplitude limiting, we might do better. . . .

The circuit of Fig. 1 is adapted from some of the oldest SSB circuitry in the books, but is still one of the least tricky arrangements around. The detector functions normally, and can be of any sort although a conventional diode is shown. The reason for this is that the detector thinks it's working with AM. . . .

Let's back off a couple of steps. Most receiver circuits combine the locally - inserted carrier with the incoming signal at the detector stage, to eliminate possible trouble with BFO harmonics which might get into the set's front end.

Since the BFO is limited in output, you're usually lucky to find 10 volts of local carrier at the second detector. In contrast, incoming

signal may range as high as 20 to 25 volts.

This causes no particular problem in CW, since you're only interested in the pitch—amplitude makes little difference.

However, for true "mixing" action as opposed to simple beat-note production, the carrier must be at least four times the amplitude of the incoming signal. Distortion will decrease as carrier increases, so the more, the merrier.

When you cut back the rf gain, you not only forced the detector into the square-law region but you also cut the level of the incoming signal down to less than a fourth that of the local carrier.

But to keep the detector operating in the "linear" region, it's far better to boost the level of the local carrier. If the local carrier is at proper frequency, the detector stage then cannot tell the difference between SSB and AM—and your ears won't notice the difference either.

By using a low-impedance potentiometer and shielded interconnecting leads, you can control the BFO voltage injected into the last *if* stage. The less voltage injected, the lower the carrier level at the detector will be.

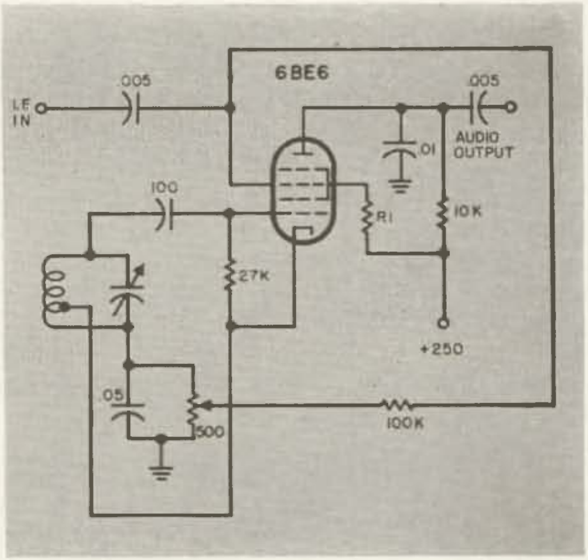
If the BFO is tightly enough shielded, it can be left in operation at all times for better frequency stability. With INJECTION controls set to zero, AM reception will be possible. Injection can then be increased as necessary for SSB and CW.

To use this trick, first tune to the SSB or CW signal with INJECTION set to zero. Tune for maximum wiggle of the S-meter needle. Then slowly increase the injection until the S-meter just stops wiggling. Adjust frequency of the BFO as necessary for a natural sound. If distortion is noticed, increase injection slowly until it disappears. You can now give an honest S-meter reading, because when the meter steadied you had injected just enough carrier to produce equivalent 100 percent modulation at the detector of your receiver. AVC will not be active, but you'll hardly notice its loss.

The only two disadvantages of this circuit, aside from the added front-panel control, are its susceptibility to BFO leakage and the nuisance of having to adjust another knob.

With these points in mind, amateur designers continued the search for a better inserted-carrier detector. One of the most successful was Murray Crosby, W2CSY. His three-triode circuit has been widely discussed in print, and a number of variations have appeared. One is shown in Fig. 2.

This circuit, originally known as the product detector (a term later applied to other SSB



detector circuits as well), requires only a small amount of BFO injection voltage and features especially-low intermodulation distortion, due to the adjustment provided.

Its operation can be explained only by resorting to columns of algebraic equations. Approximately, though, the first two triodes act as cathode followers, one driven by the *if* strip and the other by the BFO. Since they share a common load resistor, the two incoming signals are mixed in the load.

This common load resistor is also the source for the third triode, a grounded-grid amplifier. It isolates the mixing portion of the circuit from the audio output elements (and in one variation popularized by one W2NSD, was combined with the BFO cathode follower with no loss in performance). The potentiometer adjusts operating bias of the tubes, and is set for minimum distortion.

Advantages of the Crosby circuit and modifications of it have already been listed. Its disadvantages are these: 1. Audio output is much lower than from other detectors, usually requiring an extra stage of audio. 2. The detector is easily overloaded. 3. Adjustment of the IM pot is critical. 4. The circuit is complex, requiring at least two tubes and a number of extra components, not to mention a separate BFO. When used, it is best built as an outboard unit for this reason alone.

One of the next circuits announced after the Crosby detector gained popularity was the pentagrid-mixer detector. It's almost impossible to give proper credit for this one, since a number of amateurs published circuits of similar nature at almost the same time. At any rate, it was a logical development, once the point was firmly made that detection is mainly a mixing process.

Fig. 3—This pentagrid mixer circuit gives approximately the same results as the Crosby detector, with a slight increase in audio output. IM distortion is reduced by adjustment of the 500-ohm potentiometer. Value of R1 must be determined by experiment. Start with 33,000 ohms; reduce as necessary (in 5 percent steps) until no trace of distortion is heard on strong signals.

The pentagrid detector, shown in Figure 3, is almost identical to a standard mixer circuit as used in the receiver front end. The major difference is that output is taken through an audio network instead of through an *if* transformer. Another difference is the IM adjustment pot, which allows this much-simpler circuit to compete with the Crosby array on equal terms so far as distortion is concerned.

Advantages of the pentagrid detector include simplicity, low distortion, ample audio output, and the ability to substitute on a tube-for-tube basis for an existing BFO since the pentagrid detector requires only a single tube for all functions.

On the disadvantage side of the ledger are two points. The pentagrid detector, like the Crosby circuit, is extremely sensitive to overload. In addition, adjustment of the IM pot is especially critical and can only be made properly with the aid of an oscilloscope. Full adjustment details can be found in the references.

Possibly the newest entry in the field is the sheet-beam detector, which makes use of a special tube originally developed for color-television use and later announced as a SSB special by RCA.

Several detector circuits can be built around the sheet-beam tube. One of the simplest is shown in Fig. 4. It was apparently originated by ZL1AAX and later developed by RCA engineers.

The secret of this circuit lies in the tube itself. It's a cross between an rf pentode and a cathode-ray tube, having deflection electrodes where most pentodes have suppressors. With one cathode, one control grid, one screen, two deflectors, and two plates, the tube's output can be switched from one plate to the other by signals impressed on the deflectors. At the same time, the output can be modulated by a signal on the control grid.

When the *if* strip output is fed to the control grid and the BFO signal is fed to the deflectors, the average current to *one* plate (either can be used) will be a replica of the original audio. This means that output can be taken from the plate circuit.

If the *if* output is fed to the deflectors, however, and the BFO signal goes to the control grid, the audio will appear (in push-pull fashion) at *both* plates. Using a push-pull transformer will allow the BFO signal to be cancelled out, eliminating possible overload of later stages.

Audio output of this detector is extremely high—in the neighborhood of 30 volts. This is sufficient to drive the output tube directly, and in new-equipment design both the push-pull transformer and the driving stage can be eliminated by R-C coupling to push-pull audio output tubes. In adapting older gear, it's best

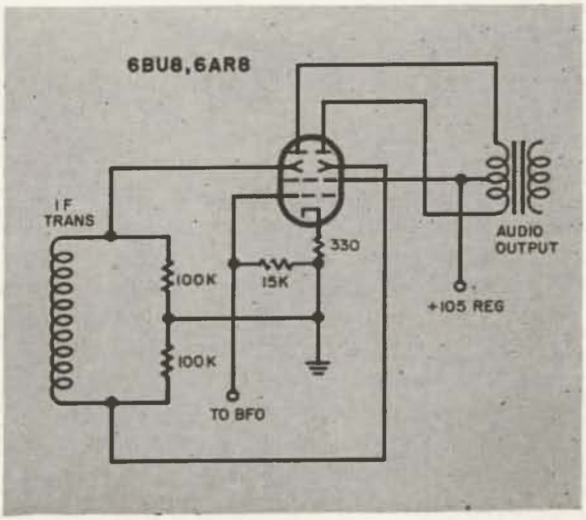


Fig. 4—The sheet-beam detector originated by ZL1AAX features minimum distortion and maximum audio output. Although a separate BFO is shown, it should be possible to use the control and screen grids as BFO elements in an electron-coupled circuit. Major disadvantage is the specia ltube required.

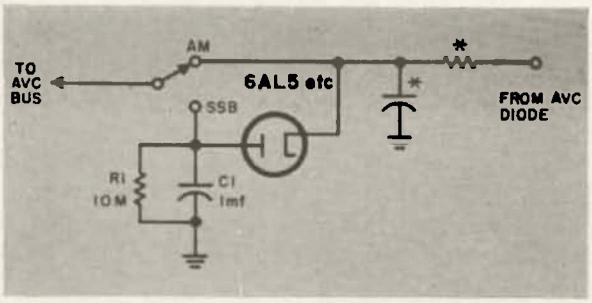


Fig. 5—This four-component circuit switches time constants in the AVC line to make it suitable for either AM or SSB-CW reception. See text for discussion of R1-C1 values and adjustment of attack and release times.

to pad the output back down to the nominal 1-volt level to eliminate readjustment of the audio gain control when switching from AM to SSB and back again.

Advantages of the sheet-beam detector include its high output, its resistance to overload, its circuit simplicity, and its low intermodulation distortion (where it's even better than the Crosby or the pentagrid, and is far superior to simple diode detectors).

Disadvantages are the requirement for push-pull circuitry, need for a separate BFO, and, most important, possible difficulties in obtaining the special tube used.

Before leaving SSB detectors and moving into AVC circuitry for use with them, one more circuit deserves mention: Webb's "synchronous detector" adapter which allows reception of not only SSB and CW signals, but DSB transmissions as well. While its advantages are numerous, so are its disadvantages: it is complex, expensive, bulky, and somewhat tricky in adjustment. Full details are found in the references; it's a full article in itself.

All the SSB and CW detectors described here (with the exception of that shown in Fig. 1) share a common disadvantage—they make no provisions for AVC.

While AVC is no necessity for reception, no one will deny that it makes listening easier —especially in a roundtable sort of operation where some stations have strong signals and others are weaker. A good AVC which brings them all to common level eliminates blasting of the eardrums.

If your receiver is a Super-Pro or a similar design, using separate channels for signal and for AVC, there's little problem. In fact, such a receiver *can* be used with no change at all, especially if separate switches control the AVC and the BFO functions. However, the attack and release time constants best suited for AM use lead to a distinct "thump" on each syllable of a SSB signal, and put a chirp on every CW station.

The circuit of Fig. 5 puts an end to such problems. The diode (which must be a vacuum-tube type) presents very small resistance in one direction but almost infinite resistance in the other. Connected as shown, it provides an AVC attack time measured in microseconds, but release time stretches out to be almost in seconds. Thus, the AVC can cut back instantly when a strong signal arrives, but gain won't be restored between syllables (or between dits of CW). Between words, normally, the gain will return.

Both the attack and the release times can be controlled independently by adjustment of values of C1 and R1. C1 controls attack time; increasing its value makes the AVC take longer to respond to a signal. With C1 set at the proper value, R1 determines release time. Increasing its value increases recovery time between signals. Values shown in the figure have been proved in practice, though they may seem unduly large.

Since SSB and CW AVC aren't suited to AM reception, the switch shown in the schematic is used to restore normal AM action. It is ganged to the FUNCTION selector on the front panel, or may be an added control.

This system of AVC won't work unless your set has separate *if* channels for signal and AVC lines. To install AVC for sideband or CW on a single-channel set, you have three choices: you can build up a complete separate *if* channel (which is bulky, expensive and

Fig. 6—This channel-splitter (two cathode followers with paralleled inputs) allows the same *if* strip to be used independently for signal and for AVC. It is connected between the last *if* transformer and the detector inputs. Interaction between the detectors is minimized by its isolating action.

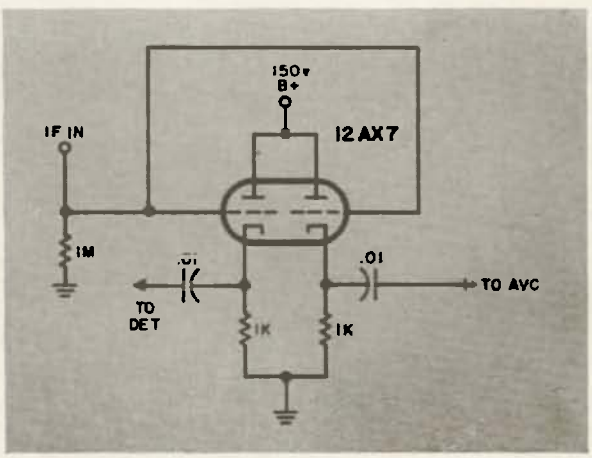
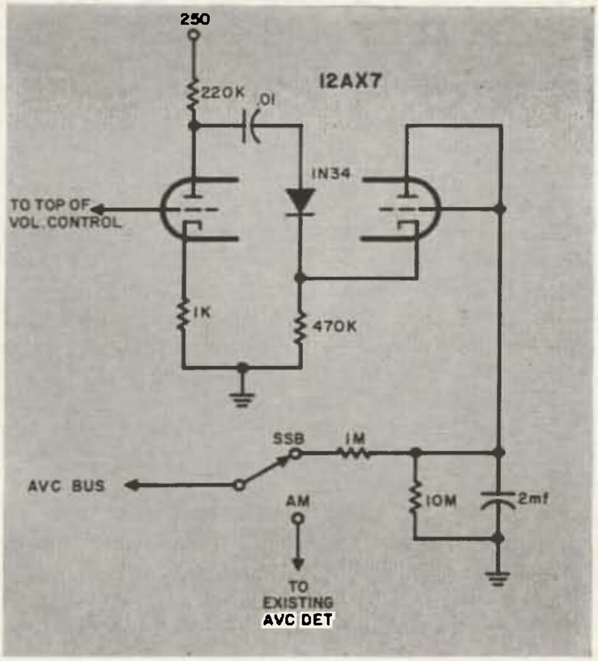


Fig. 7—Audio hanging AVC gives flattest possible characteristic for SSB and CW use. Audio is amplified in half of 12AX7, rectified to produce AVC voltage by 1N34, and AVC is gated to control bus by other half of 12AX7, diode-connected. The switch allows use of normal AVC circuitry on AM signals.



complex); you can install a twin-triode splitting amplifier (see Fig. 6) at the end of the *if* strip, ahead of the detectors; or you can install audio AVC.

Of the three, audio AVC offers more advantages and fewer disadvantages. The separate channel system has no advantages, and its disadvantages have just been listed. The splitter of Fig. 6 has the advantage of comparative simplicity (and the AM detector can be combined with the AVC channel) but is still more complex than audio AVC.

Audio AVC offers the advantage of a flatter gain-control characteristic, greatest simplicity in construction, fewest number of parts, and reliability. Its only major disadvantage, which can be overcome by careful design, is that it makes it possible to overload the detector before AVC cuts gain back. However, this effect is normally present only with AM signals of very low modulation percentage.

The circuit for an audio AVC circuit is shown in Fig. 7. Included in this circuit are the time-shaping networks of Fig. 5, in slightly different form. This circuit is adapted from one described by WØBFL three years ago. The original circuit used five tubes (in two envelopes) to accomplish its purposes. The modified circuit uses a single 12AU7 and one 1N34, allowing it to be added to almost any receiver.

That about wraps it up for now. There are countless other SSB or CW detector circuits, but virtually all are modifications of one or another of these basic arrangements. If you need additional details on any of the circuits, they can be found in the references listed below; if you can't find them there, the author below. 73

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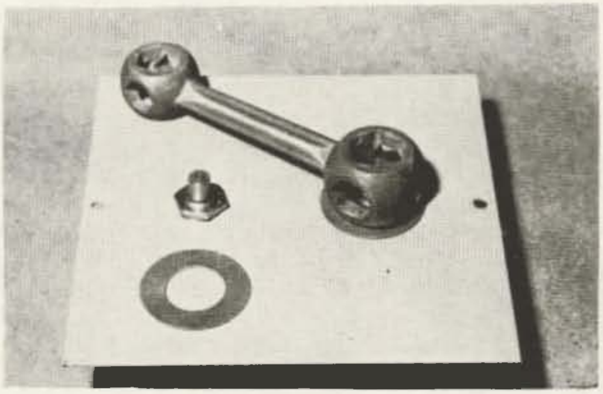
Protect the Panel

Probably the most exasperating accident that can happen in a construction project is to reach the final assembly stage and have the wrench slip as the control nuts are being tightened. A deep scratch through the decals and paint is the usual result.

A metal washer, with a center hole just large enough to clear the control mounting nut, will serve to protect the finish of the panel against tool marks. The photograph shows the method used.

. . . . Pafenberg



Up-Dating the Absorption Wavemeter

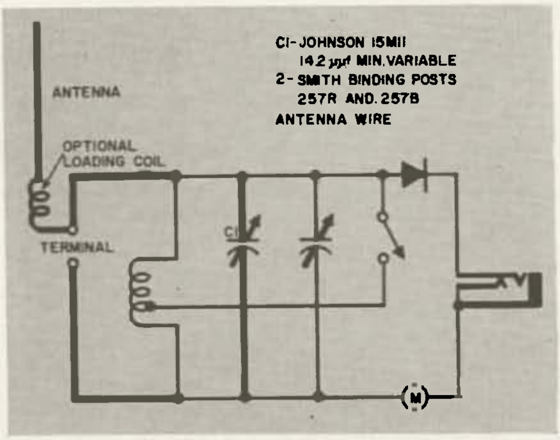
by Edward M. Noll W3FQJ

THE absorption wavemeter has had numerous applications around the station. Its resonant circuit makes rather efficient use of radiated rf energy. An absorption wavemeter can be calibrated rather closely frequency-wise and is not troubled with beats and harmonics like the more sensitive frequency meters. It is a fine device for checking-in the correct harmonic and for chasing down parasitics.

The average absorption wavemeter can be made even more versatile with some minor revisions. Many hams now have an oscilloscope at their disposal. Why not set up the absorption wavemeter to permit a convenient display of mulation envelope? Give the absorption wavemeter a little more pick up and it does well as a field strength meter. Some bandspread tuning helps out when you are concerned with a specific section of a band.

Our Triplett Model 3256 Absorption Wavemeter was the object of our modernization plan. As shown in Fig. 1A it uses a tapped coil arrangement and, therefore a single coil to cover the bands from 10 to 80 meters inclusive. A single-pole single-throw switch permits high and low band change-over. Three components were added to permit more versatile operation.

A small trimmer capacitor was added across the regular tank capacitor to act as a bandspreader. We selected a small 15 mmfd job



with a very low minimum. With the low minimum value, the main dial calibration holds up whenever the bandspread capacitor is set to minimum capacity.

Two multi-purpose binding posts were connected across the resonant tank of the wavemeter. These permit convenience in removing rf energy for oscilloscopic displays. They also provide a facility for connecting a stiff wire antenna and an associated loading coil for even better pick up. Just a three or four foot length of stiff wire has a pronounced effect on pick up. Therefore the wavemeter need not be coupled nearly so close to sources of rf energy.

If you bring the pick-up antenna into resonance by loading it works out rather well as a field strength meter. At least you can set it up outside and waltz it around the directional antenna to see what is or isn't happening.

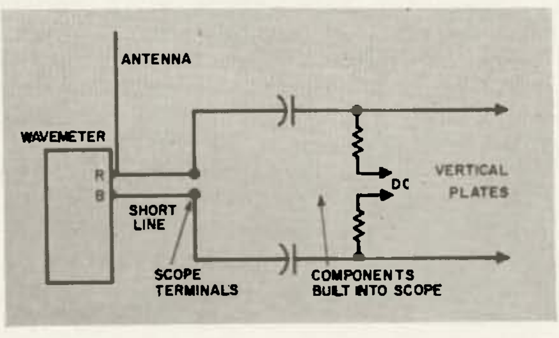
We use the arrangement to check out class D CB transmitters in the shack. It does a much better job than the untuned jobs used widely for CB testing. These are really flea-power transmitters and an improved pick-up is of great benefit.

Modulation Checks

Most service and ham-shack oscilloscopes provide easy access to deflection plate terminals. Usually a back or side plate must be removed to expose the direct-connection terminals. The connections are made via an R-C coupling network (most always built into the scope) to isolate the oscilloscope high voltages from the terminals. Thus direct lines can be run from the two added terminals of the absorption wavemeter to the direct-connection terminals of the oscilloscope. The rf energy in the wavemeter tank circuit is applied directly to the vertical deflection plates as per Fig. 2.

The use of the absorption wavemeter and oscilloscope represents an easy method of displaying a modulated envelope on the scope screen. No circuit need be broken into because no insertions have to be made into the transmitter or its transmission line. The wavemeter and a stiff antenna wire of four foot length when spaced several feet from a five watt CB transmitter picks up sufficient energy to display a two to three inch modulation envelope on the scope screen. Is there a more convenient method to check out modulation characteristics for any type of an AM or SSB transmitter?

In checking modulation on the oscilloscope an unconnected phone plug was inserted into the phone jack to take the rectifier and meter out of the wavemeter circuit. This precaution prevents high current flow in the meter circuit and clipping of the envelope. 73



The Interference Chaser

One of the most annoying forms of interference—TV, BC, HA (hearing aid), or any other kind—is that caused by audio rectification. It annoys not only the listener, who hears unwanted sounds in his set, but the ham —since the irate TV fan can easily learn his call letters and bombard him with complaints!

Of course, curing audio interference is simple. The handbooks have carried complete details for years. All you have to do is connect a low-pass audio filter ahead of the first audio stage of the affected set (see ARRL Handbook, Editors and Engineers Radio Handbook, etc.) and the interference disappears.

The trouble with this approach is equally simple—few of us like to dive beneath the chassis of a commercially-built receiver. And explaining to an unhappy neighbor, in terms he can relay to his repairman, usually proves to be a task beyond the capability of the most literate hams.

Here's a little gadget which you'll be able to whip together in half an hour or less which does all the work for you. Total cost will be less than $1.50—and most TV fans will be willing to pay for the parts when the gimmick proves its ability to chase your voice from their sets.

The Interference Chaser is a plug-in device which goes into the first audio tube socket of the affected set. The tube then plugs into the Chaser, and presto, interference is gone.

It's effective only against audio rectification. If you're having trouble with sound bars, blackout, negative images, etc., the Chaser won't help much. But against rectification, it's murder.

To build the Chaser, first determine which tube type is affected in the set. Usually, the tube location chart pasted to the back of most TV sets will give you this information. Although there's no standardized tube for the first audio position, many sets use a type 6AV6 (or similar series-string 'AV6 type) here, and the wiring diagram shown in Fig. 1 is for the 'AV6 series.

Next, gather the parts. For a 7-pin Chaser, get a Vector type TX-7-M-S "Experimenter's Tube Socket Adapter," a 47K ½-watt resistor, and the smallest 47 mmf. ceramic capacitor you can locate.

If the set you're working on has a 9-pin tube in the first audio slot, get a Vector TX-9-N-S adapter. For octal-based tubes, get the Vector TX-8-O-S. Other parts requirements do not change.

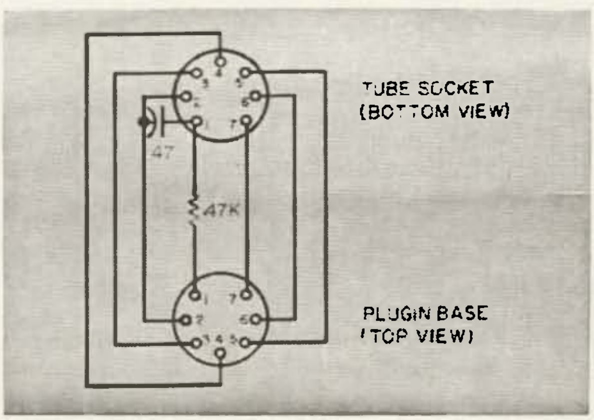
Now to the bench and soldering iron. Strap the plug and socket connections, with exception of the grid pin. By "strap," we mean connect pin 2 of the plug to pin 2 of the socket, etc., so that all connections go straight through the adapter—except the grid connection.

At the grid pin (pin 1 on the 6AV6, 6AT6, 6AU6, 6AQ5, and many but not all other 7-pin tubes), connect the 47K resistor in the circuit. One end goes to the plug, the other to the socket. Then connect the 47 mmfd capacitor from the grid pin of the socket to the cathode with the shortest possible leads.

Finally, put the shell on the adapter and you're all done with the gadget.

In operation, audio signals are unaffected by the Chaser's built-in filter since it has a cutoff frequency of approximately 150 kc. However, rf signals are greatly attenuated (more than 60 db at 50 mc) and cannot reach the tube's grid with enough strength to cause rectification.

Usually, a single Chaser clears up the interference. Stubborn cases, such as a sensitive tape-recorder amplifier operated within 50 feet of the transmitter, might require two. In this case, put one in the first stage and the other in the second. K5JKX/6



Getting the Most from Your Mobile Whip

Charles E. Spitz
1420 S. Randolph St.
Arlington 4, Virgina

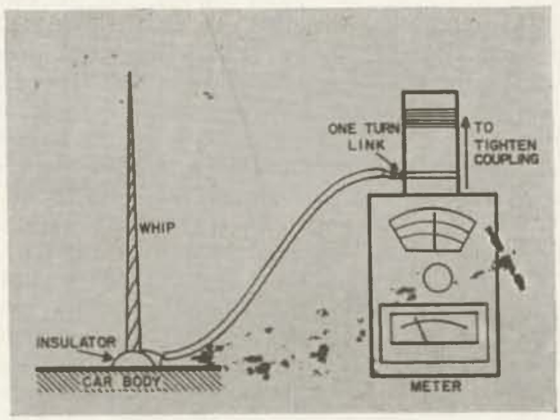
If you are one of the many who test out your new mobile rig on the big rotary beam and get these flattering reports that make you wonder if you should chuck the big juice eater out, then with unbounded enthusiasm go through the gymnastics of installing it in the family chariot .... and call and call without breaking that round table, this may be for you.

Did you ever reverse the situation and see how the big rig would work on that pretty miniature mobile whip? Well, of course no one in their right mind would mount the whip on an ash can and pump a kilowatt through it. Ah, but it should work way up on top of that fifty foot crank-up tower! In fact, I think, let's put the 40 meter whip on top of the trusty tri-bander and add forty meters to our antenna repertoire. After all, that's why we insisted upon *all-band* receivers and transmitters. One glance at the wintry breezes out of doors convinced me to share this secret thought, and after a brief discussion and with the vision of doing away with masts and long wires, my good friend Les Williams, W4ERZ ex-F7EM, volunteered.

From the comfort of my arm chair where I perused visions of new electronics devices, alarming scattered reports came in over the radio. Now alert to the situation, I found the full story deep under the heterodynes of forty meters. Les put a shiney new fiber glass whip with a spirally wound element on top of his tower. He gradually cranked in carrier and it became evident that the VSWR was good and that the thing might work. Up came the full power, then the on-the-air trials. There is an oit repeated amateur legend that says "a vertical antenna is equally poor in all directions." Even with a full kilowatt, the reports weren't just poor, what there were of them were horrible.

The tower was cranked back down, dutifully tilted over, and the antenna and all connections were examined. This type of whip has a rubber compound tip, now all blackened, splattered and charred. Even the resonant frequency of the antenna had shifted. Obviously we discovered a new type of electronic heater that did not have a good industrial application on top of an antenna mast. In fact, it certainly did not appear to have the makings of a good antenna in this application.

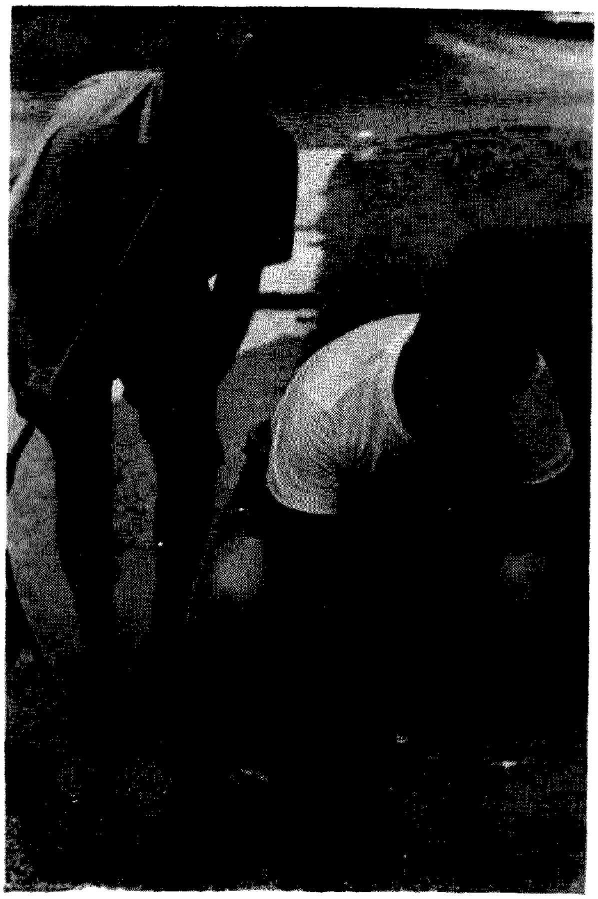
I am sure that by now you may be wondering just what all this has to do with mobile work. Well, *the effects are similar but the lower power normally used in mobile work does not show up some of the invisible forces at play so easily.* Come summer the KWM-2 was going to be mobile and these were the antennas to be used. The lessons learned should, of course, be applied.



A basic problem is to get the most from a whip. There are all kinds of whip antennas, and while there was no attempt to try them all, the experiments we made led us to think all would be similarly affected to some degree. By outlining the parameters of the situation, we find:

1. Unless there is some basic change in the art, the abbreviated whip is not very efficient; you must live with it and old man Heaviside (layer) as your chief aide.

2. The impedance should be matched to your feedline. After all, radiation *inside* your car isn't of much value!



Photograph, W4ERZ and W4APl with whip and grid-dip meter.

3. The antenna should be resonant at your operating frequency. (Ha! sez you, *I know that!* Yes, but did you ever do anything about it?)

Problem One is beyond our control. Problem Two can and usually is taken care of with the trusty Micromatch. Most people come afoul of Problem Three and do nothing about it. With the spirally wound glass whips this is tricky. One of the purposes of this article is to give you the courage to use a hacksaw on that pretty whip yet retain it's trade-in value.

In order to tune up the antenna mounted on your car, you must simulate operating conditions in all respects. This mean you do this away from buildings, people, and car doors and trunks must be closed. Your chief tool is the grid dip meter and receiver. You may have to drill a hole in the body of the car (out of sight, of course!), so you may run a twisted pair to a grid dip meter link and yet close the trunk. You may elect to do your measuring on the car seat (hoping you have foam rubber seats, and not nasty inductive coil springs), using the car rig low impedance antenna feedline. The tricky part of this operation is to keep the antenna very loosely coupled to the grid dip meter by a link so you can be sure of the resonant frequency. Note your basic resonant frequency and write it down. You must be sure of it, because this is where the hacksaw comes in and your rate of change is noted. You saw off the end of your antenna, one inch or one-half inch at a time as illustrated in the chart.

The photo shows the proper attire for the experiment—in midsummer. The picture actually shows how not to do it, as the whip should be mounted on the car and people as far away as possible.

The purpose of Fig. 1 is to insure familiarity with the proper hookup to any grid dip meter. Twisted pair or light co-axial cable may be used to couple the meter to a one turn link on the appropriate coil for the band used. The coupling may be "tight," that is near the coil, for initial location of the resonant frequency of the antenna. The "big dip" is what you are looking for. The link is then backed away from the coil, however in doing so you will note that the grid dip meter frequency has changed. The process may have to be repeated until you are sure you have the correct frequency, which will be the only appreciable big dip. Grid dip meters are notoriously poor in calibration, therefore when you have the correct spot, tune it in on a frequency meter or good receiver in order to get the exact frequency.

Our aim was to cut a 40 meter Shakespeare Wonderod Model 62-6 whip to 7210 kc and a Model 62-7 to 3975 kc, for SSB operations. The chart illustrates the cautious inch-by-inch measurements as the whips were pruned with a hacksaw. You will note that as the frequency goes up, the effect of the winding pitch of the spiral antenna and inductive effect increases the frequency change per inch. This will become more critical on higher frequency band antennas.

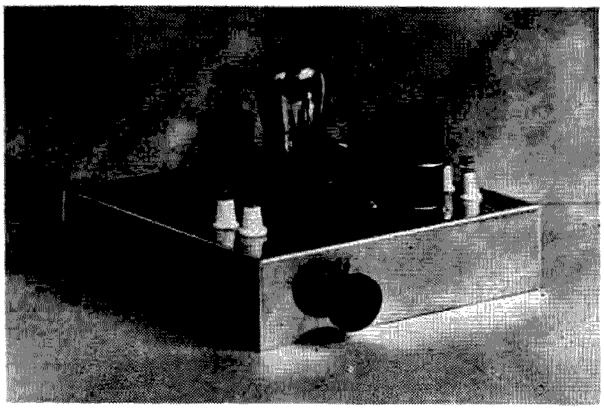
What happens if you cut too much off? Remember our rubber compound tip? Placing the tip back on the 80 meter whip *lowered* the frequency from 3975 kc to 3955.5 kc! This opens up the possibility of frequency recovery by the use of the capacitive effect of a lossy dielectric such as the rubber compound. Various types of tape should do this also, and there should be no difficulty just as long as you don't feed a kilowatt in to the antenna! 73

Frequencies Shown are Without Rubber Tip

80 Meters One Inch Steps, Sawed Off Tapered End	40 Meters One-half Inch Steps, Sawed Off Tapered End
Basic Frequency—3855 kc	Basic Frequency—7046 kc
	—7073 kc
—3900 kc	—7109 kc
	—7134 kc
—3933 kc	—7168 kc
	—7192 kc
—3975 kc	—7210 kc

How Modern is the VFO?

Howard S. Pyle "YB"W7OE
3434 74th Avenue, S.E.
Mercer Island, Washington

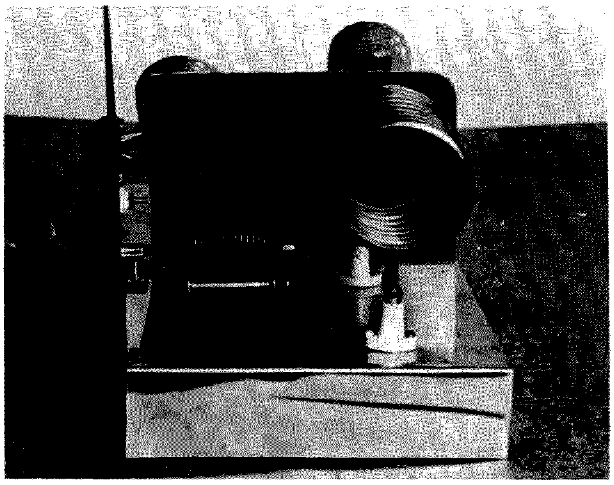


Tuned-plate, tuned-grid transmitter of the 30's. Grid coil on left, plate coil on right.

NEWCOMERS to the ham ranks take the "variable frequency oscillator" or "VFO" as it is popularly termed, for granted. If they have entered the field via the Novice route, a VFO is of course, 'forbidden fruit' until such time as they qualify for a higher class of license. Surprisingly enough, a large number of relatively "old timers" among the General class licensees accept the VFO as a development of fairly recent years. Let's see *how* recent!

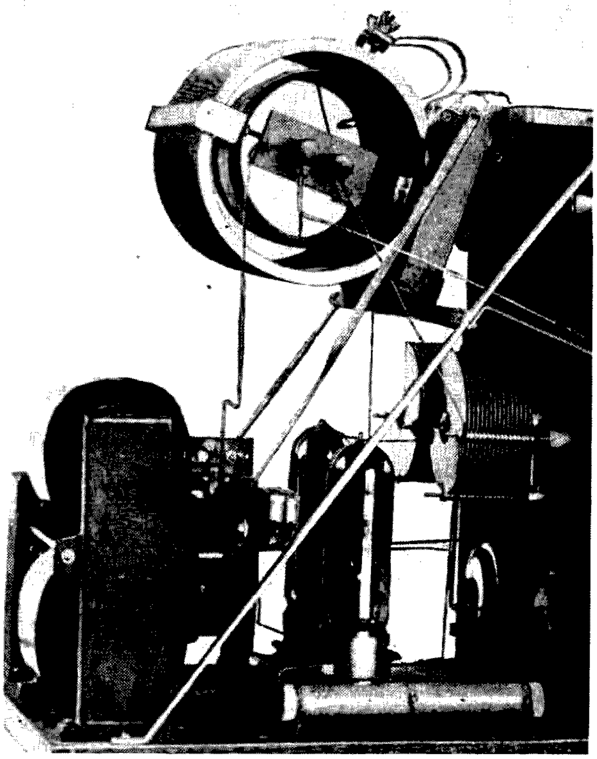
Right after World War I, when the ban was lifted from amateur operation (October 1919), great interest was exhibited in the vacuum tube as a generator of radio frequency oscillations not only by hams but by commercial companies and the military services as well. Experimental work in various laboratories during the period of hostilities had rather conclusively demonstrated that great possibilities were evident here. While vacuum tubes had previously been used to a limited extent, chiefly by Dr. Lee deForest, their inventor, as radio frequency generators, they were not popularly accepted either in amateur circles or by commercial operating interests; "spark transmitters predominated in the wireless/radio communication field. How could you possibly work any DX with 5 or 10 watts of power from a little lamp when you had trouble covering three to five hundred miles with a quarter or half kilowatt "rock-crusher"?

A tunable oscillator of the late 20's.



Probably the greatest single incentive which brought the turn to vacuum tubes for transmission was the development and production for the U. S. Navy by the Western Electric Company working in conjunction with the Bell Telephone Laboratories, of the CW-936 RADIO TELEGRAPH AND TELEPHONE TRANSMITTER / RECEIVER. Nominally rated at ten watts, it employed a VT-2 oxide-coated filament type of vacuum tube as the radio frequency oscillator. A similar tube acted as a power amplifier. Oxide filament tubes of smaller physical size and rating, designated as the VT-1, were employed in the receiver portion of this compact unit. The CW-936, initially designed for the small WW-I subchasers, performed so surprisingly well that they soon found their way aboard destroyers and not long thereafter were included in the radio equipment complement of more major war ves-

sels. Hundreds of hams among the thousands who had enlisted in naval service, found opportunity to use and evaluate these little rigs. Much thoughtful pondering resulted: "H-m-m; ten watts? Only 350 volts of direct current at a few milliamperes and yet we work hundreds, even *thousands* of miles? Maybe it's because we are at sea on an unbroken expanse



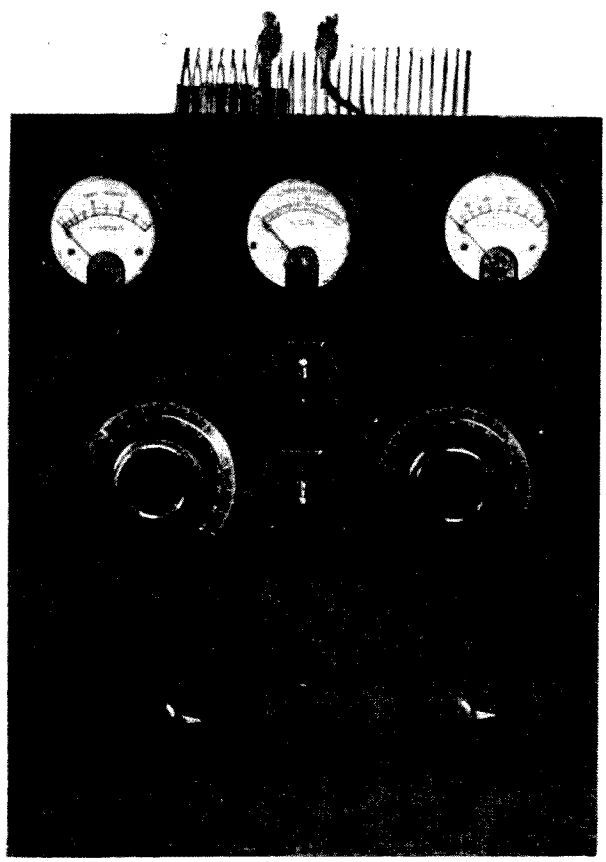
Side view of the 200 meter transmitter. The grid coil is mounted inside the edge-wound plate inductance.

of salt water but too, maybe they've got something there! If we ever get out of this navy and back on the air, let's try it!"

And they *did!* The transition period was relatively slow; many "die-hards" who had only *heard* of the marvelous performance of the tiny vacuum tube . . . they had not been assigned where they could actually observe this . . . still swore by 'spark' and stuck to their guns. Just the same, more and more of the peculiar, high-pitched whistles began to appear in the regenerative receivers of that day. The remarkable thing was that such stations, many a thousand or more miles distant, were consistently heard stating that they were using only 5, 7½, 10 . . . only a very few were reporting as much as *fifty* watts of power! Remember too, that the frequency or 'wavelengths' as it was then referred to, was in the neighborhood of 200 meters or 1500 kilocycles, admittedly far less effective than the much higher frequencies which we use today. And, the use of vacuum tubes seemed to offer a solution to a whale of a lot of problems which had been plaguing the development of the radio *telephone!* It began to look like it wouldn't be *too* long before the hams could converse by means of the human voice, as well as the more conventional keyed characters of the radio telegraph code!

That did it! Somewhat of a landslide started. Hams by the score were investing in transmitting vacuum tubes and appropriate power supply components, both of which were beginning to appear on the open market. Tubes were available in several wattage ratings; most popular at the outset was the UV-202 which was, if my memory isn't faulty, rated at 7½ watts. In most cases, the ham woefully overloaded them and they ran closer to 15 or 20 watts in many rigs even if their metal plates did turn a cherry red or better! But they worked! It was not long before the UV-203 tube, with a rating of *fifty* watts appeared.

100 watt 200 meter transmitter circa 1924. The wavelength was adjusted by the two variable condensers.



They were costly . . . initially $30.00 each and some ambitious rig builders required *two;* they were just as subject to burn-out and breakage as the relatively less expensive smaller tubes, but a number of hams gobbled them up, perhaps paralleled two of them as a 'high power oscillator' or used one as an os-

cillator, the other as an 'amplifier' with higher voltage and current input.

And what did the ham use for an oscillator circuit? Current magazines were literally saturated with construction articles and schematics covering vacuum tube transmitters. Circuits were devised, altered and 'improved' practically overnight. It made your head swim; what to use? Invariably an 'oscillator' tube was employed; it was the actual radio frequency generator and the real heart of the rig. Hartley and Colpitts oscillator circuits were the most popular among the early experimenters. Basic equipment was the tube, an inductance coil, variable condenser and a small handful of fixed condensers and resistors; maybe an rf choke or two. Often the inductance for even a five watt rig was wound of ¼" copper tubing or even larger! It just didn't seem reasonable that a transmitter would work with smaller diameter conducting material when we remembered that our spark rigs invariably called for such copper "pipe" or heavy copper ribbon for the "oscillation transformer"! Look at the oscillator coil in your rig today; probably wound with #20 or #22 wire; the final amplifier coil in even a half kilowatt modern rig, seldom uses anything larger than #10 copper wire!

Many of these initial tube transmitters consisted merely of an oscillator feeding directly into an antenna; no buffer, no intermediate or final amplifiers; strictly a one tube job (ignoring the rectifier tube or the 'slop-jar' rectifier, of course!). And, by simply moving clips on the oscillator coil and adjusting the variable condenser, any frequency within the L/C limits of the circuit components, could be rapidly tuned! What was *that* other than a 'variable frequency oscillator' . . . a VFO?

Many, many more circuits were tried, accepted or discarded. For a long time, what was known as the "tuned-plate tuned-grid" circuit was highly in favor. In effect, it was merely the conventional oscillator circuit of the time with a tuned plate circuit, to which had been added additional L/C components in the *grid* circuit, making that also tuneable. Whether this was any gain over the simpler oscillator circuit alone or not, is somewhat of a moot question today; at any rate they worked good . . . I used one for a couple of years.

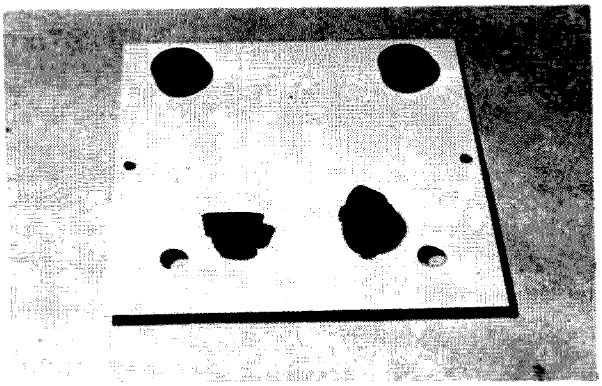
The commercial companies as well as the military communication branches were not asleep either. The amateur was pointing the way with his impressive increase in signal exchange distance and the exceptional sharpness of the emission permitting dozens more stations to operate within the frequency sector formerly dominated by one spark signal! As with the amateur, newly designed commercial equipment incorporated a "tuneable oscillator" to which the power amplifier and the antenna could be resonated throughout the frequency range of the equipment. What were *these* other than 'VFO's' basically?

Amateur as well as commercial and military equipment has been through a program of continued progress and improvement ever since Marconi startled the world with his reception of the letter "S" across the Atlantic Ocean in late 1901. Prior to World War I, development of 'spark' equipment from the simple spark coil of Marconi, to 500 cycle, quenched spark gap equipment, took place. Subsequent to WW-I, with the impetus which it gave to vacuum tube transmission, developments have continued at even greater . . . almost fantastic . . . speed. The use of vacuum tubes are even now threatened to a considerable extent by a relatively newcomer . . . the transistor. Remember though, that just like the progress of spark transmission which, right up to the last, required high voltage, large components and a spark discharge gap to create rf oscillations, the vacuum tube *first* required an oscillator to create rf generation, just as it does today. The earliest vacuum tube oscillators of record were capable of frequency variation . . . the forerunner of our present VFO! Do you still think a VFO is something "new"? 73

Improved Mounting Feet

Although commercial rubber "bumpers" or protective mounting feet are manufactured for installation on electronic equipment, they are often difficult to locate and the proper size may not be immediately available.

Automotive supply stores stock replacement rubber hydraulic brake cups in a variety of sizes and prices on these items are reasonable. The photograph shows the original unit and its installation in a metal plate. The groove at the top securely holds the foot in the mounting hole. The rubber tip which projects into the cup is cut off with a pair of diagonal pliers.



These mounting feet are a distinct improvement over those commercially available. The suction cup action will hold the equipment securely in place on any reasonably smooth surface.

. . . . Pafenberg

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LPA-1 Kit—(less tubes, cabinet and blower)	$269.50
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LPS-1 Kit—(complete with cabinet but less tubes)	$169.50
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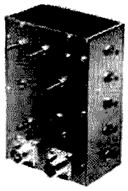
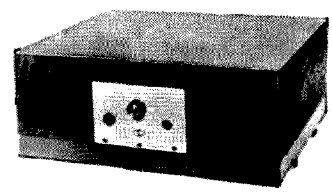
LPS-1 Power Supply—Factory wired and tested Complete with cabinet and tubes	205.00

(See Nov. QST, page 115 and Nov. CQ, page 21, for outstanding features)

KITS AVAILABLE IN FEBRUARY



LPA-MU Matching Unit Price $36.00
LPA-MU-2 Matching Unit Price $36.50
Factory wired and tested



LPS-1 Power Supply for LPA-1

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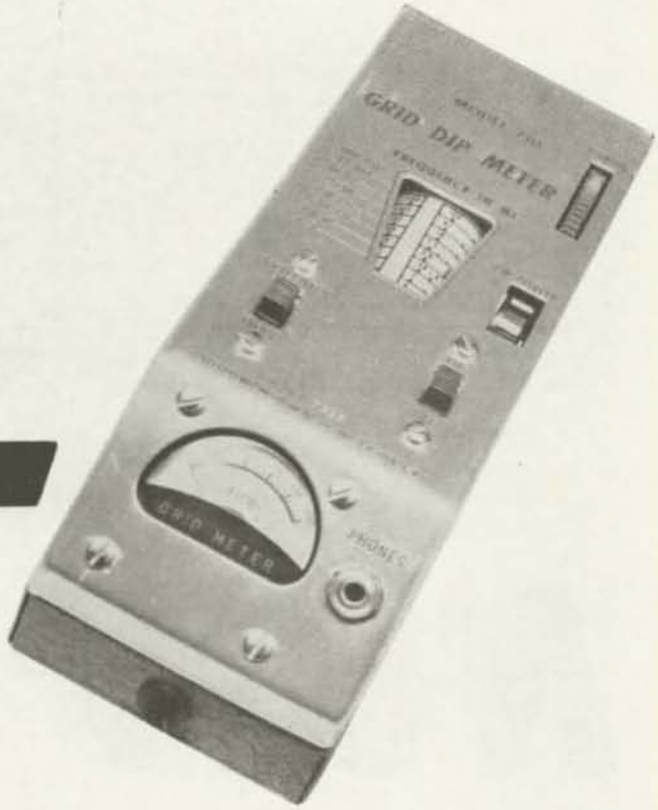
73 Tests the EICO 710 G. D. O.



Donald A. Smith—W3UZN
Associate Editor

Price: $29.95
Time for construction: 3 hours
Range: 400 kc—250 mc
- A. 400-700 kc
- B. 700-1380 kc
- C. 1380-2900 kc
- D. 2900-7500 kc
- E. 7.5-18 mc
- F. 18-42 mc
- G. 42-100 mc
- H. 100-250 mc

Input power: 117 vac at 10 watts (little enough to be used with a small inverter in your car)
Warm up time: 90 seconds for use; 3 minutes for stability
Uses: Checking frequency of a tuned circuit
- Modulation monitor
- Crystal checker
- Marker generator
- Signal generator
- Oscillation detector
- Neutralization detector
- Finding capacity of unknown condenser
- Finding inductance of unknown coil

Note that tuning and sensitivity controls are on right, making for simple one-hand operation.

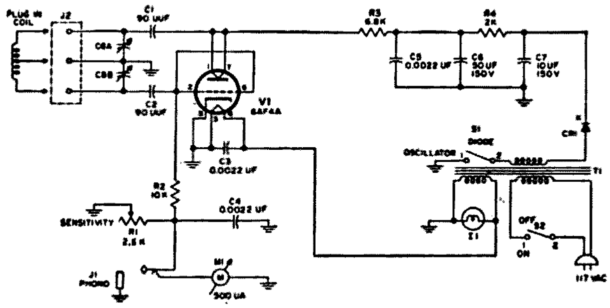
A GRID dip meter is one of those *must* pieces of equipment for the ham shack. By building one you can save money and become completely familiar with the unit at the same time. The Eico Model 710 comes in kit form and sells for $29.95. It has a band coverage of 400 kc to 250 mc, with all coils pre-wound and calibrated.

The unit is very small (2¼" high, 2 9/16" wide and 6⅞" long), permitting easy, one hand operation. It has its own built-in ac power supply, as well as a 500 microampere meter for reading oscillator current. The frequency scales are on a cylindrical drum which is rotated through 340°, all scales having the same length. The front panel is brushed satin aluminum, with markings etched into the panel. The cabinet is a grey finished steel, for ruggedness and good shielding characteristics.

The circuit used in the Eico G.D.O., is a Colpitts oscillator, using the excellent 6AF4A high frequency triode. Eight different ranges between 400 kc and 250 mc are provided by eight pre-wound plug-in coils. All scales are 3¾" long. A sensitivity control is placed in parallel with the 500 μa meter to adjust the oscillator current to a mid-scale reading. A switch is provided to cut off the B+ to the oscillator, thus permitting the circuit to work as a tuned diode detector. A headphone jack is mounted on the front panel for CW or phone monotoring, and zero beat purposes. The meter is automatically disconnected when phones are used and the sensitivity control is used to control the volume at the headphones. A pilot lamp is included to provide light for the dial scales.

Building the unit requires some care, though it is not difficult. It is necessary to keep the leads short in the oscillator circuit. Also, the unit was designed to be compact, which is a real advantage when using it in tight places. The oscillator tube is mounted at an angle, as can be seen in the photos, reducing lead length and lowering stray capacities. The oscillator circuit is wired first with the power supply and other parts following. The drum (dial scales) and gearing between the drum and variable capacitor are mounted after the wiring is almost complete. The gearing system almost completely eliminates backlash in the dial system. The meter and phone jack are the last to be wired before the unit is mounted in its cabinet.

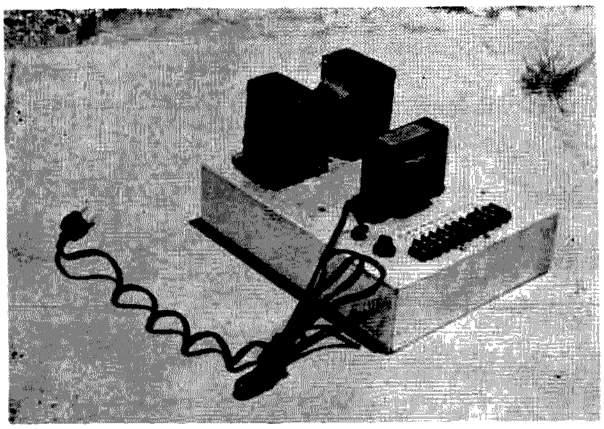
Eico has done a very complete job on its instructions for the *use* of the unit. The manual explains over one dozen uses, including the finding of "Q" in a circuit, unknown inductance, checking neutralization, etc. Drawings are provided in the manual, showing various methods of coupling the g.d.o. to tuned circuits, crystals, etc. This feature of the instruction manual will be of great help to the amateur who has not used a grid dip meter before.



Shacks

No matter how elaborate the equipment or ornate the setting, the room where Johnny ham sets up business is called "the shack." This is not because a good many such installations do actually deserve such a name, it's just a part of the old ham tradition. In the early days of amateur radio, communication of sorts was accomplished with the aid of motor-driven spark gaps, chemical rectifiers in fruit jars, extremely high voltages and huge antennas. No mother or XYL would tolerate the accompanying odors, din and acute danger of fire and explosion anywhere in the house. The only solution was a 'shack' in the backyard. Long after spark was replaced by CW, shacks remained popular for the privacy they afforded and were frequently seen right up to WWII. Now, years later, the shacks are gone but the term continues on.

W∅HKF



Power for the Old Pro

Jim Kyle K5JKX/6

ONE of the best buys around on the surplus market—when you can find it—is the BC-779 receiver. In its civilian dress as the Hammarlund Super-Pro, the rig is well-known and justly famous.

The old Pro, however, has one design feature which is at the same time an advantage and a disadvantage. The power supply is on a separate chassis from the rest of the receiver.

Most of the time, this is a great help. The receiver runs cooler, there is less trouble with induced hum, and weight of each unit is somewhat lessened.

The only time it proves to be a severe disadvantage is when you find one in your surplus supply house—without power supply.

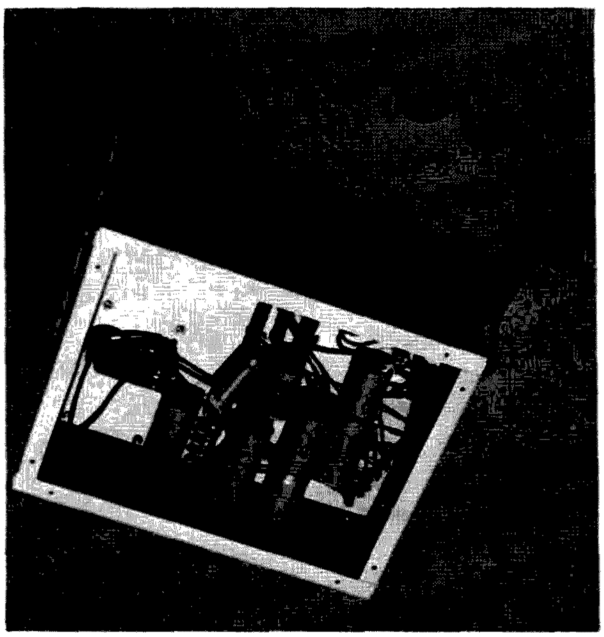
"So what," do I hear you ask? "What's so tricky about building a power supply?"

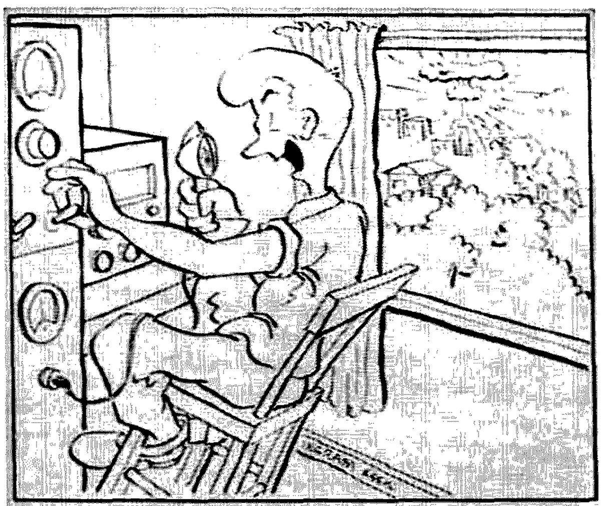
Really, it's not so hard. But the Super-Pro power supply, actually, is not one but two separate supplies. One furnishes 385 volts at 100 ma, 310 volts at 80 ma, and 270 volts at 50 ma. The other furnishes negative 50 volts for fixed bias. And duplication of the original power-supply circuit proves to be an expensive, time-consuming operation.

Here's a modified Super-Pro power supply, presently doing yeoman duty on my BC-779. Using a combination of old and new ideas, this supply furnishes all operating voltages for the Pro, at a total cost of less than $40 is all parts are purchased new. Any good surplus hound with a fair junk-box to dig through can trim the cost to $10 or less.

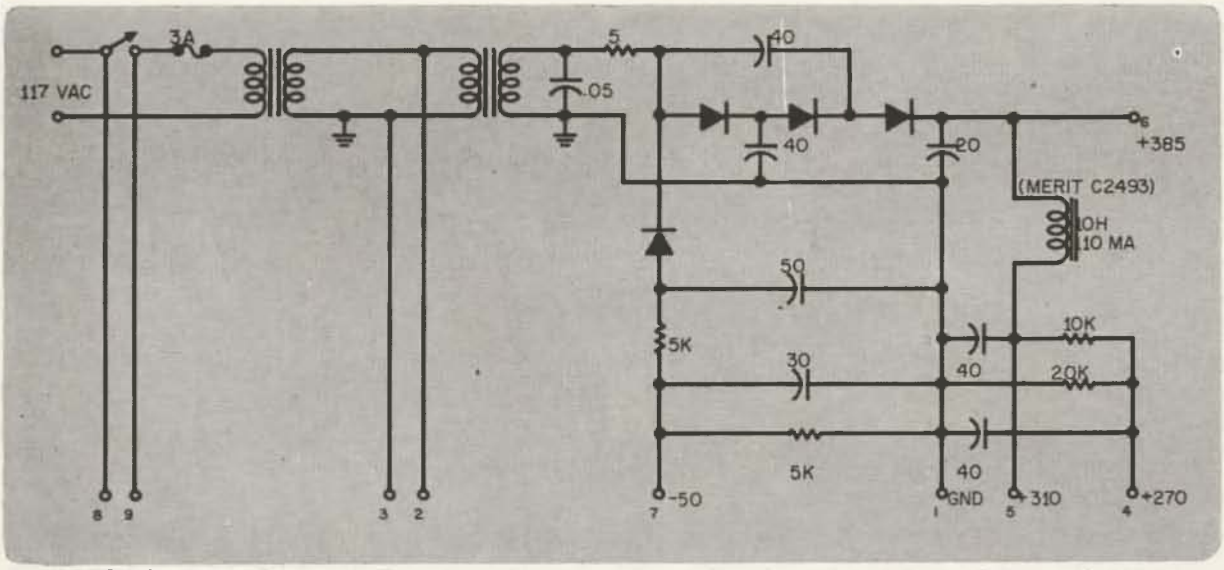
This supply uses two 10-amp, 6.3-volt filament transformers, connected back-to-back, for isolation purposes as well as to supply heater power for the receiver. The isolated 117-volt ac then goes to a voltage tripler using silicon diodes. This tripler provides the positive voltages. Highest potential under load is approximately 350 volts. Although this is slightly lower than the design value for the receiver, no ill effects have been noticed.

In addition to feeding the tripler, the transformers also feed a half-wave rectifier which also uses a silicon diode. This diode is connected with reversed polarity to provide bias voltage.





WELL JIM YOU SHOULD HAVE YOUR KW FINAL HOOKED IN NOW, SO LETS SEE HOW IT SOUNDS ACROSS TOWN HERE...



A stiff bleeder and plenty of filter capacity assure steady bias voltage regardless of overall load on the supply.

All connections are shown on the schematic diagram, Fig. 1. No part of the writing is critical. However, be sure the solder joints are good—the original model blew one filter capacitor because of a poor solder joint.

If you want to raise the output voltage of the tripler a bit, double the capacity of each capacitor in that part of the circuit. This will raise output voltage to 395 under load, but will also raise the voltage tapped down the bleeder accordingly and some modification of bleeder-resistor values may be necessary.

If you have a Super-Pro sitting around the shack waiting for a power supply—or know where to find one cheap but have been held back by lack of power for it—this simple circuit may be the answer to your problem. Try it and see!

Editor's Note: Even if you never see a Super Pro this is a darned good power supply idea to keep on file.

Ham Headlines

If ham radio makes the newspapers in your town please send a clipping to Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Marvin runs the 73 News Service, a montly publication sent to all editors of club bulletins. He will digest the most important stories that are submitted each month for us to print in 73.

Cash

Everywhere I go people want to know what sort of articles we're looking for. My yardstick is simple: if the article is interesting and accurate I want to print it. Haven't you designed something unusual which your friends have been asking about? Drop a card for our style sheet and get to it. . . . W2NSD

. . . Precision Switching

at Specified

Current Levels

is Easily Achieved

with

This Unusual Application

of Polar Relays

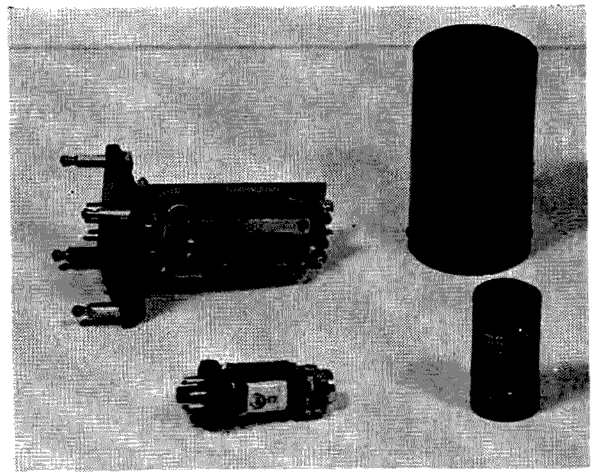


Photo by Jim Gardner

The Sigma Series 72 polar relay is shown in contrast with the much larger Western Electric 255A relay.

Roy E. Pafenberg
P.O. Box 844
Fort Clayton
Canal Zone

Differential Switching with Polar Relays

THE need for relay operation at an easily adjustable, preset current level is a common requirement that is very difficult to meet with conventional relays and standard circuitry. Commonly available relays are designed and factory adjusted to trip at a specified voltage or current and to release at a point substantially below the closing point. While the closing current is fairly well controlled in production, the release point is not and generally ranges between 30 and 60% of the value required to close the relay. A real problem exists when an application necessitates field adjustment of both the pull-in and drop-out points of an available relay.

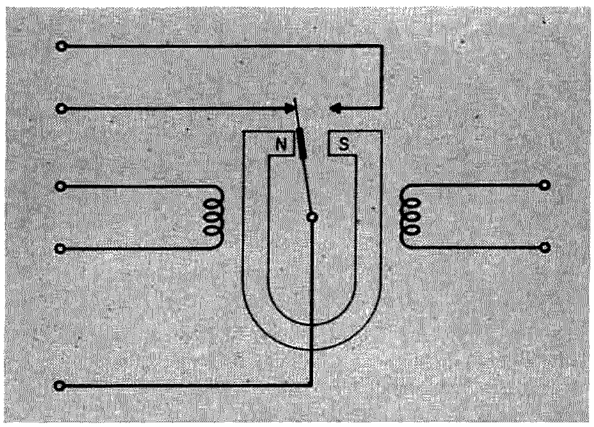
The commonly accepted method of providing an easily adjustable relay is to select a more sensitive unit than is actually required and to shunt the operating winding with an adjustable or variable resistor. An example will show that this further increases, in actual current, the undesirable spread between the operate and release points of the relay. Assume that the winding of a relay, which normally closes on a current of 100 ma and releases when the current drops to 60 ma, is shunted with a resistor of the same value as the resistance of the winding. The relay will now close on 200 ma and drop out at 120 ma. The

Sigma Type Number	Resistance Each Coil	*Basic Relay Sensitivity	Operating Range Min. Max.	Bias Supply	Bias Series Resistance
72AOZ-10-TS	10 ohms	5.60 ma	5.60—240 ma	6 v	12— 1,250 ohms
72AOZ-160-TS	160 ohms	1.40 ma	1.40— 60 ma	12 v	25— 10,000 ohms
72AOZ-400-TS	400 ohms	0.90 ma	0.90— 38 ma	18 v	50— 20,000 ohms
72AOZ-1000-TS	1000 ohms	0.56 ma	0.56— 24 ma	32 v	250— 60,000 ohms
72AOZ-2500-TS	2500 ohms	0.35 ma	0.35— 15 ma	48 v	600—150,000 ohms
72AOZ-4000-TS	4000 ohms	0.28 ma	0.28— 12 ma	54 v	400—200,000 ohms

*Current required through one coil to switch unbiased relay.

difference between the operate and release points has increased from 40 to 80 ma. This characteristic could easily make an otherwise suitable relay unusable in certain shunted applications.

Fig. 1. Basic elements of the polar relay. The signal winding current must overcome the "bias" of the permanent magnetic field before the relay will switch.



The deficiencies cited above can, for many applications, be overcome by the use of a polar relay. This relay, in its most common form, consists of a floating armature positioned between the poles of a permanent magnet field. The armature may rest against either pole of the field and is magnetically latched in either position. This configuration is known as the "either side stable" type of polar relay. The armature is the center contact arm of the signle pole, double throw contact arrangement normally provided. Two identical operating coils are provided as signal windings, either or both of which may be used. Operating current, applied to a winding, depending on the polarity, either presses the armature more firmly against the contact or transfers it to the other contact. Once transferred, the armature remains in this position until an operating coil signal of the

opposite polarity returns it to the original position. Figure 1 shows the basic elements of a polar relay.

These relays have been used in the communications field for decades. They are precision sensitive relays, with the sensitivity very closely controlled in manufacture and adjustment. The magnetic latching characteristic of these relays is known in the communications industry as bias and this normal permanent magnet bias may be augmented by flowing a current through one of the two windings. When current, of the proper polarity, is passed through the other winding and exceeds the bias current by an amount equal to the basic sensitivity of the relay, the relay will switch. When the signal current drops below the bias current by the same amount, the relay will switch back. In other words, regardless of bias current, the differential between the operate and release conditions of the relay is always constant and equal to twice the basic sensitivity of the relay. Therefore, by regulating and controlling the bias current, it is possible to extend the basic precision of these relays over an extremely wide range of operating currents. As an example, if the unbiased sensitivity of a polar relay is 0.5 ma and a bias current of 50 ma is applied, the relay will switch on a signal winding current of 50.5 ma and switch back when the signal current drops to 49.5 ma.

While many manufacturers make polar relays, the new Sigma Instruments, Inc. Series 72 units are representative of the various types and are readily available in a number of basic sensitivities. The chart shows the published characteristics of the various types and also gives bias supply values and operating ranges computed for the application shown in Fig. 2 and described herein:

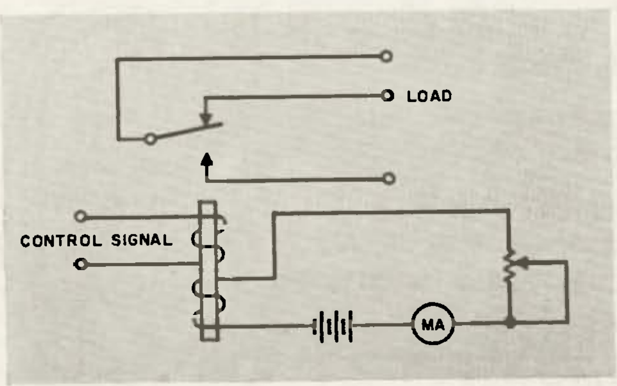


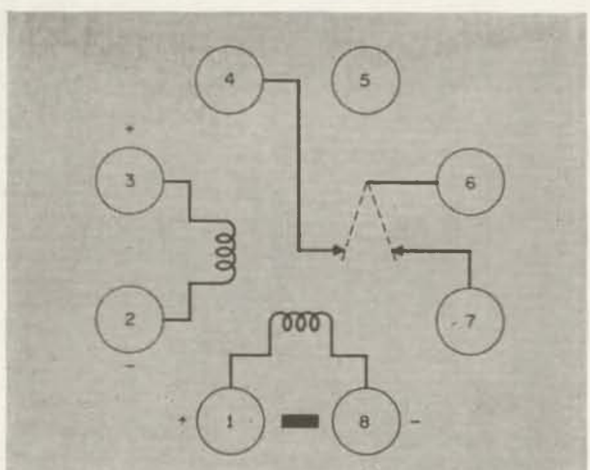
Fig. 2. This circuit provides precision switching at easily adjustable signal current levels. See text for component values.

Fig. 3 shows the base connection of the Series 72 relay. The operating range shown in the chart indicates the range of bias current adjustment possible for each type of relay. The pull-in current will be this value plus the indicated sensitivity of the relay, while the drop-out current is the value shown minus the sensitivity of the relay. The minimum currents shown are limited by the sensitivity of the relay, while the maximum current is determined by the rated dissipation of the relay windings. The bias supply voltages listed were arbitrarily selected to provide a voltage greater than that actually required to allow a full range of adjustment. The same considerations apply in the maximum and minimum values of resistance specified. In one extreme, the maximum dissipation of the relay coils is slightly exceeded and the bias current is dropped below the sensitivity of the relay in the other extreme.

Care should be exercised in the selection of the series resistors in the event an application requires adjustment through the complete range of current. While adjustable and variable resistors are rated in wattage dissipation, a maximum current limitation is imposed. This rating is usually that value of current which results in the rated wattage dissipation when the total resistance of the unit is in the circuit. Use of switched fixed resistors and a lower value adjustable or variable resistor will permit the use of lower wattage units.

Those readers that have regarded relays as necessary evils, to be used only when a remotely located switch must be actuated, are in for a pleasant surprise when they explore the infinite variety of circuit functions that may be more simply performed by modern relays. The example cited herein is only one of many valuable applications of the polar relay. While semi-conductor devices are being used for many switching functions, the relay will be with us for many years to come. While apparently simple, the application and use of relays is an intriguing subject and familiarization and experience with these components can be of great value in the development of the technician. 73

Fig. 3. Bottom view of the base connections for the Sigma Series 72 polar relay. Polarity shown closes 6 & 7.



(. . . de W2NSD from page 8)

A combination of curiosity about this record and a desire to add to the 45 rpm program material which I have been collecting to use on my car record player made me throw caution to the winds and send in the quarter.

The record came. It was interesting too. I turned up the volume a bit as I bounced along. Suddenly I almost went through a red light when I heard my own voice coming from the record talking to Mirko, YU1AD as part of the demonstration of what you might hear on the ham bands. What a surprise! I looked around for someone to tell, but all around me were the usual kids in Buicks waiting to out-drag my little sports car at the light and fat cigar smoking men in Cadillacs trying to elbow me off *their* road. It's very frustrating when you have something exciting to tell and no one to tell it to.

Perhaps finding my own voice on the record colored my opinion, but I sure found the record interesting. It (the record) should, I think, help get a lot of people listening to the short waves.

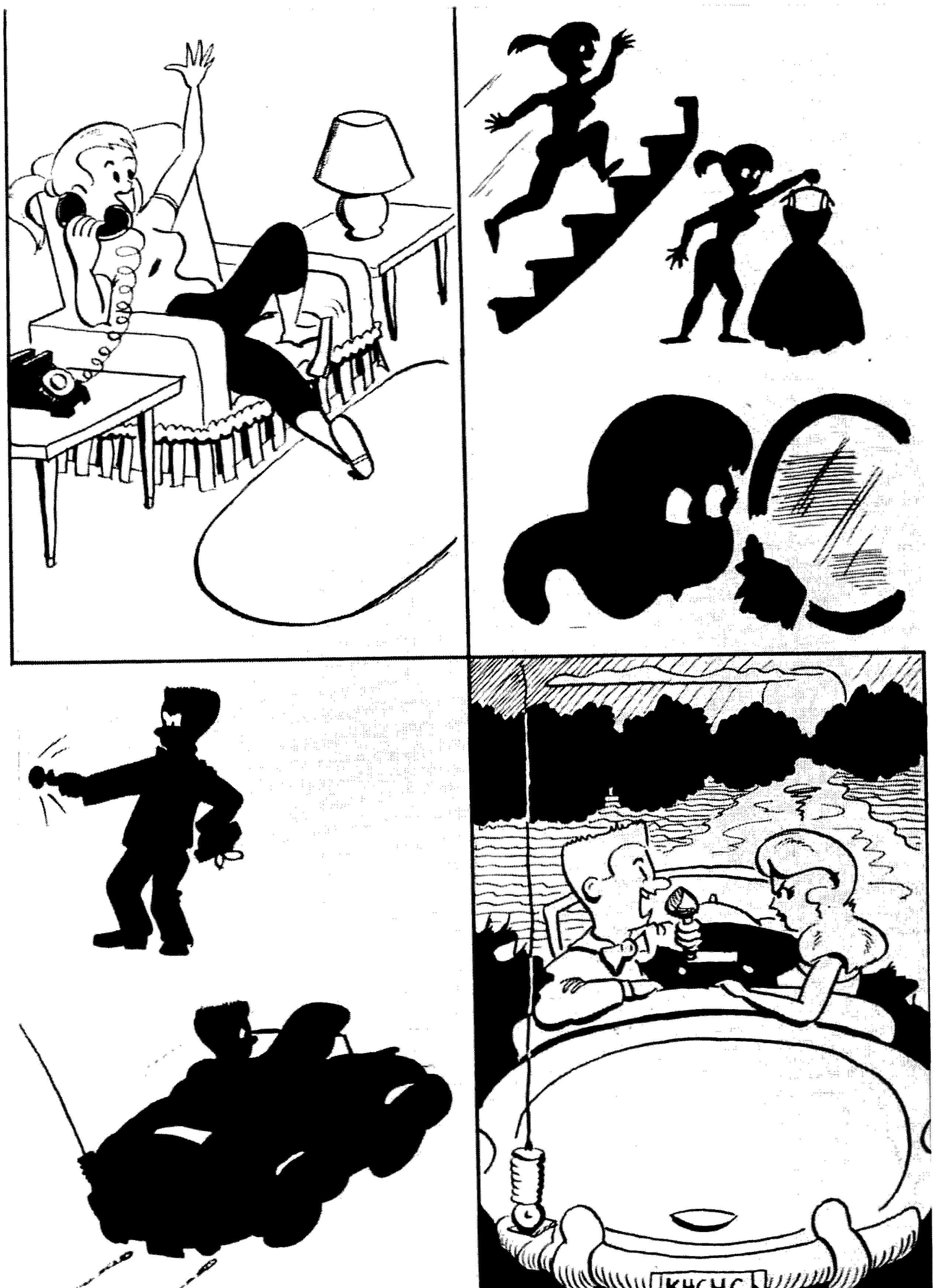
Late January

The January issue of 73 was mailed on January 3rd to all subscribers from our post office in Norwalk, Conn. All copies were mailed at one time. A checking copy was included to our office in Brooklyn. Thus turned up on the tenth! Copies were reported being received from Long Island hams as late as the 16th. The ways of the postal service are hard for us mortals to understand.

New Books

John Rider has just published a book which will be of great interest to our younger readers, though the price is a bit stiff for them. This is **Basics of Analog Computers** by Truitt and Rogers. How come such a complicated book for youngsters? Well, first of all, as any of you who have invested in Rider books know, by the time John gets through publishing a book the subject has been rendered understandable. Secondly, as everyone knows, computers are growing into a tremendous field, one which you would do well to consider if you still are trying to decide which way to head in this life. Teenagers who take up ham radio are years ahead of the fellows who go into electronics in or after college. It is a shame to waste all this time just in playing around on two meters when it could be used to develop understanding in computers, UHF, or some of the obviously big electronic fields ahead. In addition to giving you a good foundation for understanding analog computers, this book is fun to read. You will never be quite the same once you've read it. 400 pages. $12.50. John Rider, 116 West 14th Street, New York.

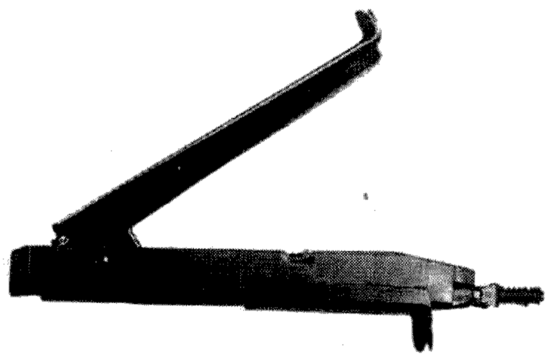
Gernsback Library has a new book by G. J. Christ; **Tubes and Circuits.** This book goes into good detail on the theory of vacuum tubes and their applications. When you get through with this 192 pager you should have a good understanding of the whole subject. $3.45 paper covered; $5.00 cloth bound.


K4CHC

Here's a New One in Tools

We have recently had occasion to try out a most exciting new tool addition to the workshop equipment of the ham who likes to build his own gear; the ADEL NIBBLING TOOL. And it's *just* that; a "nibbler." Mystified? Well you might be unless you're "in the know." This tricky little device takes all the hard work out of cutting odd-shaped holes in metal panels and chassis as well as in tubular metal parts within its generous thickness liimts.

The "nibbler" will bite holes in sheet metal up to 18 gauge steel or 1/16" copper or aluminum in just about any formation you can



think of. Cut your initials in a piece of rain pipe down-spout or your call letters in a panel; square, rectangular, oval or round cutouts for component mountings, as easily as you punch cardboard with a paper punch! Enlarging holes of any shape is 'duck soup' for this little hickey; stick his snout in the hole and do a bit of 'click-click' finger squeezing and you've got a clean, smooth hole of the size and shape you want!

And . . . the *best* part . . . less than $4.0υ for this handy contrivance and we'll bet that your local ham jobber already stocks it. If not, write Adel Tool Co., 4640 Ronald Street, Chicago 31, Illinois for further information.

CUT IT OUT!

Run, do not walk, to the nearest U. S. postal service depository and get the votes in for the articles in this issue of 73. List at least your first five choices as to interest. Winning author gets big bonus. You get nothing out of it but fervent thanks from said author and better articles in the future.

—Rolling Your Own	—Interference Chaser
—Varicap Amplifier	—Mobile Whip
—Simplest Patch	—VFO Modern
—2M Pip-Squeak	—EICO GDO
—Squawk	—Pro Power
—6M Converter	—Differential Switching
—Heath Patch	—Propagation Guessing
—Life Insurance	—Editorial
—Absorption Wavemeter	—Beat Generation

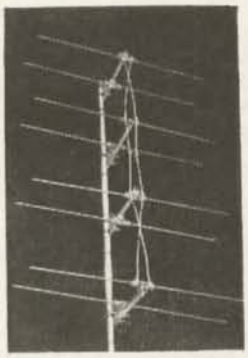
"I'M KNOCKIN' OFF FOR A COUPLE HOURS DAVE - GETTING MARRIED."

A Use for the Surplus 717A

The surplus 717A is a World War Two vintage high frequency pentode that has been seen in "Radio Row" for as little as ten cents. It was used extensively in military VHF gear. It has the same base connections as the 6SK7 and is directly interchangeable with it. The ARC-5 receivers have three 12SK7's used as rf and *if* amplifiers and the 717A comes in handy when converting these receivers for six volt operation. The 717A is also useful in increasing the gain and sensitivity of older receivers employing 6SK7's in the rf or *if* stages. This is because the 717A has almost double the transconductance of the 6SK7.

. . . WA2AKT

New Product



VHF Beams

Cushcraft has just announced a new line of light weight, mechanically balanced 16 element beams for 144-220-420 mc bands. These are designed so they can easily be ganged for larger arrays. They match any coaxial or open feed line and have a gain of 13.2 db over a dipole. The booms are made of ¾" drawn aluminum tubing, the elements of ¼" and the stacking bars of 3/16" heat treated solid aluminum rod. A lot of care has gone into the design of these beams. If you're buzzing around the VHF's you'll want to have all the info on these new beams. The prices are very reasonable (only $16 for the Two meter 16 element beam). *Cushcraft, 621 Hayward Street, Manchester, New Hampshre.*

Letters

Dear Wayne:

Three cheers for W9EAM (on p. 57) for the boost for CW.

According to WØHKF (on page 6) 50 cycles is dead. For the record I would like to state that approximately half of my salary for the past year was earned modifying equipment &/or proving it would work properly on 50 cycles as well as on 60 cycles. Yesterday was really a looloo. The equipment likes to have one side of the power line grounded, but the 50 cycle generator has one side 40 volts and the other side 60 volts above ground, with about 118 volts betwix the two leads. A 5 cycle component is also impressed on the 50 cycle. Doesn't he like to work DX? Japan uses 50 cycles at 100 volts, Germany 50 cycles at 220 volts, and others use 25 cycles and 43 cycles.

Roy A. McCarthy, K6EAW
Fullerton, California

Letters

Dear Wayne:

Congratulations on the January issue of 73 Magazine. I found it many times more interesting than the corresponding issues of brands X & Y. K8ERV's article on the Nuvistor Converters for 6 & 2 was excellent; loaded with food for thought and caused a good many friends and myself to ask, "Why didn't I think of that?"! The "See-Saw Bleeder" of KV4CI was a novel take-off on an old "Hints & Kinks" idea but deserves praise for bringing it "up-to-date." Heaps of luck, keep up the good work on 73.

Al La Placa K2DDK
Manhasset, N. Y.

Dear Wayne:

I just finished reading the January 1961 issue cover to cover. There really is a lot of article-pages inside. Here is a run-down on my thoughts on the contents.

The following were, I thought, above ordinary. They are listed in order of preference.

1. **Polarity Test Paper**—W2QCI. This article was worth the cost of the magazine. It is the cleverest and most useful idea I have seen in a long time. However, why not use sodium chloride instead of potassium chloride? It works just as well and might be easier to come by (table salt, you know). This system is really sensitive.
2. **1296 Mc/s**—Very good article.. Glad to see things on the pioneering phases of hamdon.
3. **Lost in a Tunnel**—Same thing goes for this one.
4. **Nuvistor Converters for Six & Two**—Very good construction article. One thing I don't understand, tho. What is a "conventional turned plate circuit" (P. 10)?
5. **A-M Detectors**—Very good techical article.
6. **Transistorized . . . Receiver**—Good "see what can be done" article.
7. **Down with Drift**—Another good technical article. I would also like to add the use of heat dissipating tube shields to his list.

The rest of the articles were satisfactory. They are not listed except for three which deserve some comment.

Goblin Patrol—Good "public service" article but it paints a horrible picture of teenagers.

Transistorized Frequency Standard—Gives the impression that a 100Kc/s oscillator is the trickiest circuit in existence.

6N2 Completed—Gads ! ! ! Is this a sign of the future? Will the technical magazine of 1965 be a collection of permutations of commercial equipment? Will the amateur become like the Hi-Fi Fan (audiophile?) who "constructs" his own system? 'UZN could have at least built and designed his own power supply. This one really shook me up.

All in all this was a very good issue. I did not realize that there was so much space devoted to articles until I read the whole thing in one sitting. Keep up the good work.

Arnold Reinhold, K2PNK

Ha, ha, ha . . . he doesn't know what a turned plate circuit is.

Dear Wayne:

K3EBB (Mack) loaned me his copies of your first three issues and I was delighted with what you are doing. I particularly like the preponderance of construction and technical articles and was further pleased to note that so many of your writers were top drawer. If you can continue to entice articles from men like Herb Brier, Jim Kyle and my very good friend John Specialny, then you really have it made. Thanks too, for the nice plug of the AF-MARS Eastern Technical Net Sunday afternoon broadcasts, my particular interest. Query: Who got number 1 on the Xmas cover, you or Jim?

Earl Henson, W3ZNF

Me.

Flying Hams

Jack Gutzeit W2LZX
75-02 168th Street
Flushing 66, New York

For some time now I have been noticing that more and more of the fellows I contact are also interested in the hobby of flying. After talking to a dozen or so fellow flyers, I began to keep a list. The list has grown and grown, but still is far from complete. I would appreciate knowing of any additions that you could suggest. Some of the better known flying hams are:

W1ZD—John M. Wells of the Harvey-Wells Company, a pilot since 1930 and a ham since 1920, now flys his Beech Travel Air for business and pleasure.

W2AQK—Frank Melville of the Melville Radio Distributing Company, White Plains, New York, another old timer now flying a Bonanza.

W2DIO—George Zarrin of the Harvey Radio Company, New York, who started both ham radio and flying more than 25 years ago, today is very active in both radio and CAP activities.

K4LIB—Arthur Godfrey (need we comment?)

K6BX—Clif Evans received his Navy Wings in '27, has flown 138 different types of aircraft and has over 14,000 hours logged, now retired as Commander and very actively engaged in ham radio and The Directory of Certificates and Awards.

W8QBF—J. Donald Shirer, Chief of Police at Olmstead Falls, Ohio.

K4RFA—Curt LeMay, General in the United States Air Force.

KØDWC—Francis "Butch" Griswold, General in the United States Air Force. 73

W1BMR
W1BZH
K1EGO
W1IZ
K1IZM
W1JIB
W1JM
W1JTB
W1LZV
W1NPY
W1PRI
W1SBM
W1TIM
W1VLT
W1YUO
W1ZD
W2AS
K2AAN
W2ABK
W2AQK
WA2AVT
W2BAE
W2BHD
WA2BCS
WA2BRY
W2BKX
W2BMV
K2BPM
W2BPV
W2BUS
K2BVY
W2CAN
K2CNF
K2CTK
K2CTR
K2CYA
K2DGI
W2DHN
W2DIO
W2DR
W2DZV
W2EHV
K2ENC
K2EZC
W2FCJ
W2FDL
W2FME
W2FWG
W2GG
W2GJX
K2GBN
K2GMV
W2HBK
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K2HOK
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K2IHD
WA2IMA
K2IND
K2IOG
K2IQX
W2ISY
KN2IUM
W2IUX
W2IVW
W2IXD
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W2MRJ
W2MRY
K2MWN
W2NNU
W2NRM
W2NSD
W2NXZ
W2OBW
W2OZD
W2PNR
W2PYK
W2PZE
W2RCQ
K2REC
W2RHN
W2RJM
K2RMA
W2RNN
W2RRP
W2SCH
W2SIM
K2TAQ
K2TOL
K2VAU
W2VEG
W2VGQ
W2VHS
W2VKS
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W2ZGA
K2ZMX
K2ZPJ
W2ZRY
W3AMO
W3CO
W3DJV
K3IBD
K3IBE
W3IXL
W3JSN
K3KBI
W3PGH
W3PQR
W3ZP
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K4CUGI
K4DLH
W4DNO
W4EEF
W4EHD
W4FHB
K4GGS
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K4GTZ
W4GQV
W4HAV
W4HCZ
K4IHS
K4IWB
K4JKP
W4JQG
K4LBT
K4LKY
K4LIB
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K4MLZ
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W4SHG
K4SIX
W4SJO
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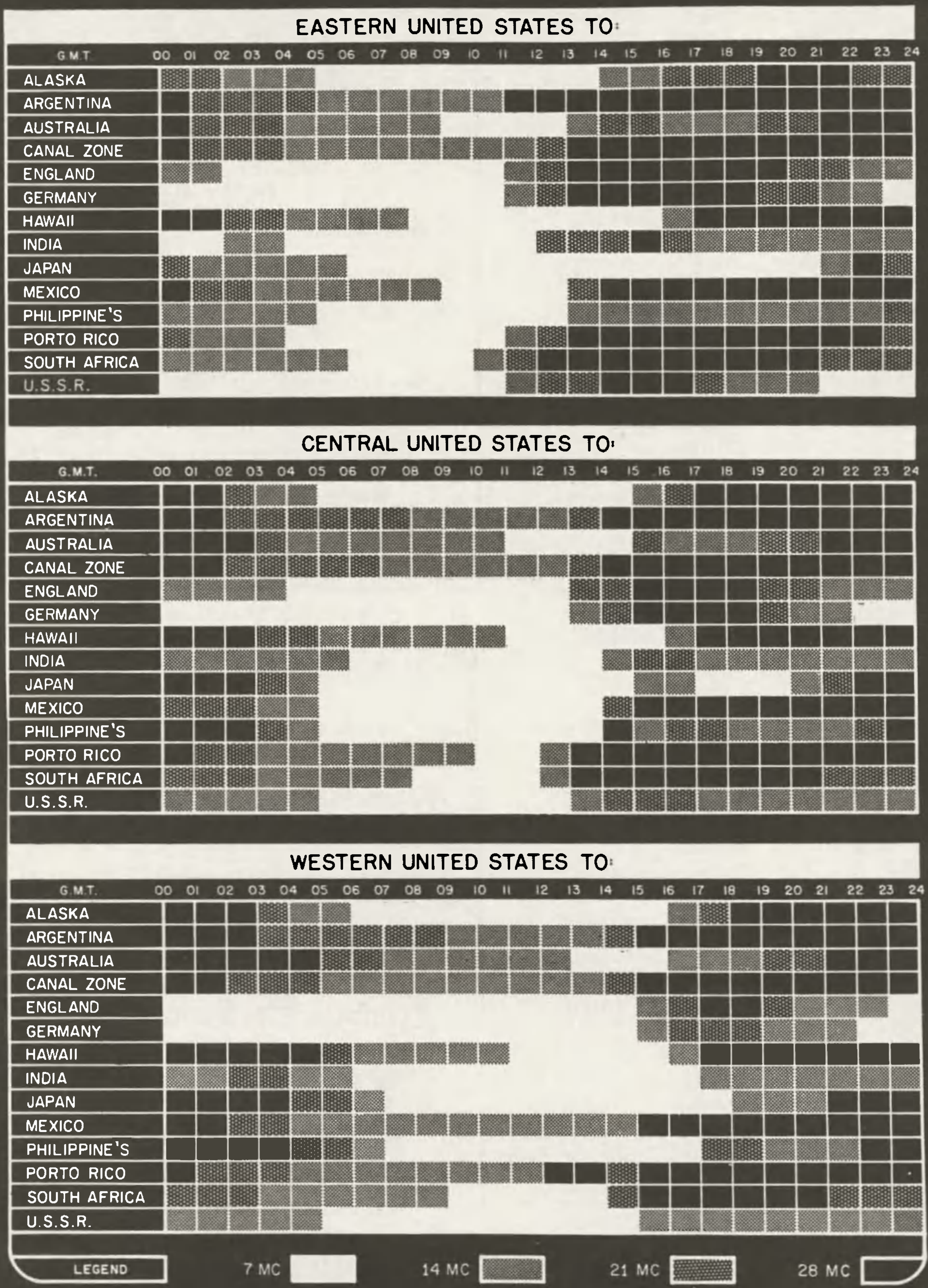
W4UPZ
K4USM
W4VIW
W4VTT
W4WSS
K4YCX
W4YGY
W4YIU
K4YYJ
W4ZKE
W4ZWA
K5BGG
K5BTE
K5CNI
K5DCM
K5MRU
K5NFM
W5OZI
W5QK
K5SDM
W5ULI
W5YCK
W5YQO
W5ZRA
K6BX
W6BZ
K6CUK
WA6DBG
W6EFB
W6EPJ
W6LI
W6OJK
K6QPI
W6RMT
W6SRE
W6ZGZ
K6ZXW
K7AEJ
W7AMU
W7AOD
K7BCK
W7BPS
K7CET
K7DSR
K7ENQ
W7ETK
W7GI
K7GHZ
W7GKC
K7LMU
W7LZU
K7MAT
W7PYY
W7VBP
K8BTL
K8CFU
K8DXC
W8EAI
W8FBV
K8GBE
W8GDC
W8GDE
W8HNY
W8HWJ
K8KSA
K8LTS
W8LVQ
W8MGB
W8MRJ
W8QBF
W9AON
W9AXL
K9BYK
K9CJH
W9DIA
W9DDN
K9DOX
K9EEK
W9EMR
W9GDS
W9GQI
W9GXA
K9HFN
W9IEF
W9IZI
K9JFZ
W9JUV
K9KUC
W9KYV
W9LBH
K9LFW
W9LXS
W9MOW
W9OGP
K9OTY
W9PMO
W9RBX
W9RHS
W9TGM
W9TQT
W9TRN
K9UML
W9UWL
K9VDW
W9VXE
W9WAF
W9WNT
K9WXO
W9ZWF
WØABF
WØBRK
WØDSM
KØDWC
KØFIC
KØGRL
WØGZ
WØIBZ
KØJST
KØKFQ
WØLZL
WØLZU
WØNOD
WØOUS
WØRAM
WØRPE
WØRXK
WØTGL
WØVOP
KØWKO
KØZFR
DL4TN
EL4A
GI3CWY
HC1FO
HC1NX
KL7AHP
KL7DJD
LU2ZA
LU2ZO
LU2ZR
LU2ZS
LU2ZY
LU8CW
LUØCQ
VE2GQ
VE2WW
XE2FA

PROPAGATION CHART



Propagation Charts

David A. Brown K2IGY
60 New York Avenue
West Hempstead, N. Y.

The bands listed are MUFs and a higher band will not work for the time period listed. Lower bands will work, but not nearly as well. Times are GMT, not local time.

These charts are to be used as a guide to ham band openings for the month of February, 1961 to the various countries listed. I will be interested to hear of your results in using these charts and to know what other areas you might wish included in future charts.

Advanced Forecast: February 1961

Good 5-10, 16-21, 24-28

Fair 1-2, 4, 11-13, 15, 22-23

Bad 3, 14

Crystal Grinding Powder

One of the details that seems to puzzle embryo crystal grinders is where to latch on to the necessary abrasive powder. Simple. There are almost as many rockhounds around the country nowadays as there are hams. The stuff is known to them as "grits" and they use it by the pound in their tumblers to smooth and contour their rock specimens. It shouldn't be difficult to get on the trail of one and talk him out of a few spoonfuls of 400 or 800 grit. Failing that one can always look up "Lapidaries" in the classified phone book and buy it like the rockhounds do . . . by the 5 lb. bag.

WØHKF

Air Force MARS
Eastern Technical Net

Sundays
2-4 PM EST 3295kc 7540kc 15,715kc

Feb. 5—Dr. Michael Cefola: Titration With High Frequency Radiation
Feb. 12—Fr. Clarence Schubert: The Electronic Emission Microscope
Feb. 19—Robert Gunderson: Electronic Test Equipment For the Blind Communicator
Feb. 26—Vice Admiral Robert B. Pirie: Patriotic Rearmament Through Education
Mar. 5—Dr. C. R. Kelly: Physics and Chemistry of Pure Metals

Subscription Deportment

There seems to be a misunderstanding here that needs immediate corrective measures. Can you possibly have failed to notice that we have printed 4 (four) subscription blanks below this puff? Do you for one moment think that we ran out of interesting things to publish and decided just to fill up the page with sub blanks? Perhaps we'd better spell this out in plain language so there will be no more confusion. We put four subscription blanks below so you could fill out four subscription blanks and send them in. You may even make reasonably accurate facsimilies of these four blanks if you wish to carry an uncut copy of 73 through the rest of your life. Now, if you are already subscribed then you are supposed to put the names of four friends in the blanks and send them to us, together with just enough money to add up to a minimum of $3 each. It is none of our business where you get the money. If you have not yet subscribed for yourself then please use one of the blanks to remedy this oversight.

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Capacity Meter (December 73)

Make a note on page 15 of the December 73 that L1 is 65 turns of #32 wound in three layers on a ½" slug tuned form. The tap is 15 turns from the ground end. L2 is 37 turns of B&W Miniductor 3012 (Air-Dux, 632, ¾" idameter, 32 turns per inch), tapped at six turns. Better put this note in now so you won't have to hunt when you start building this gadget.

/MM's

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Radio Bookshop

Instead of wishing you had these books why not try getting one a month until you have a decent reference library? These are carefully selected: no dogs.

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22—BEAM ANTENNA HANDBOOK—Orr (W6SAI). Basics, theory and construction of beams, transmission lines, matching devices, and test equipment. Almost all ham stations need a beam of some sort . . . here is the only source of basic info to help you decide what beam to build or buy, how to install it, how to tune it. $2.70

23 — NOVICE & TECHNICIAN HANDBOOK — Stoner (W6TNS). Sugar coated theory: receivers, transmitters, power supplies, antennas; simple construction of a complete station, converting surplus equipment. How to get a ham license and build a station. $2.85

24—BETTER SHORT WAVE RECEPTION—Orr (W6SAI). How to buy a receiver, how to tune it, align it; building accessories; better antennas; QSL's, maps, aurora zones, CW reception, SSB reception, etc. Handbook for short wave listeners and radio amateurs. $2.85

28—TELEVISION INTERFERENCE—Rand (W1DBM). This is the authoritative book on the subject of getting TVI out of your rigs and the neighbors sets. $1.75

32—RCA RADIOTRON DESIGNERS HANDBOOK—1500 pages of design notes on every possible type of circuit. Fabulous. Every design engineer needs this one. $7.50

33—WAVE PROPAGATION & ANTENNAS—Welch. Highly recommended by the propagation experts as the best book on the subject.

40—RADIO HANDBOOK, 15th EDITION—Orr (W6SAI). This is far and away the best amateur radio handbook ever printed. Over 800 pages. $8.50

45—CURTA COMPUTER. The world's smallest computer. Send for detailed information. Makes the slide rule look sick. Like a Monroe computer only hand size. $125.00

52—HOW TO READ SCHEMATIC DIAGRAMS—Marks. Components & diagrams; electrical, electronic, ac, dc, audio, rf, TV. Starts with individual circuits and carries through complete equipments. $3.50

53—BASIC ELECTRONIC TEST PROCEDURES—Turner. This book covers just about every possible type of electronic test equipment and explains in detail how to use it for every purpose. Testing: audio equipment, receivers, transmitters, transistors, photocels, distortion, tubes, power . . . etc. $8.00

57—QUAD ANTENNAS—Orr (W6SAI). Theory, design, construction and operation of cubical quads. Build-it yourself info. Feed systems, tuning. $2.85

58—ANTENNAS FOR CITIZENS RADIO—Orr (W6SAI). General coverage, mobile and directional antennas for 27 mc. band. Build & tune 'em. $1.00

69—5-9 SIGNALS—Orr (W6SAI). A manual of practical, detailed data covering design and construction of highly efficient, inexpensive antennas for the amateur bands that you can build yourself. $1.00

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82—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. III—Original and conversion diagrams, plus some photo of these: 701A, AN/APN-1, AN/CRC-7, AN/URC-4, CBY-29125, 50083, 50141, 52208, 52232, 52302-09, FT-ARA, BC-442, 453-455, 456-459, BC-696, 950, 1066, 1253, 241A for xtal filter, MBF (COL-43065), MD-7/ARC-5, R-9/APN-4, R23-R-28/ARC-5, RAT, RAV, RM-52 (53), Rt-19/ARC-4, SCR-274N, SCR-522, T-15/ARC-5 to T-23/ARC-5, LM, ART-13, BC-312, 342, 348, 191, 375. Schematics of APT-5, ASB-5, BC-659, 1335A, ARR-2, APA10, APT-2. $3.00

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RATHER than devote half or more of 73 to the printing of news of interest to specialized groups we believe that it is our function to do everything possible to encourage the publishers of bulletins which cater to these interests. These bulletins bring you the news you want in far greater detail and in much less time than is possible in a monthly magazine where it usually takes two months for news to get into print.

HAM-SWAP. Published by Ham-Swap, Inc., 35 East Wacker Drive, Chicago 1, Illinois. Editor is Ed Shuey, K9BDK. Subs are $1 per year by 3rd class mail, $3 for 1st class, $5 airmail, and $7.20 special delivery. Published once a month. Contains classified ads entirely. This is your best bet for an inexpensive way to sell or swap some gear in a hurry. Within two weeks people are answering your ad.

FLORIDA RTTY BULLETIN. Fred W. DeMotte W4RWM, P.O. Box 6047, Daytona Beach, Florida. $3 per year including membership in Florida RTTY Society. Mostly operating news with a bit of technical info now and then. All TT men should be getting this.

SOUTHERN CALIFORNIA RTTY BULLETIN. Merrill L. Swan W6AEE, 372 West Warren Way, Arcadia, California. $2.75 per year, not including membership in Society. Operating news and some technical articles. This is the oldest TT bulletin going. All TT men should also get this one. Monthly.

73 HAM CLUB BULLETIN. Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Sent free to all editors of ham club bulletins monthly to keep them abreast of what is going on with all the other ham clubs. This is an excellent source of news for putting together your club bulletins. To subscribe to this news bulletin just send a copy of your own club bulletin to Marvin.

Advertisers Index

Alco 57
Alden 54
Allied Radio 64
Alltronics-Howard 55
Arrow 2
Barker and Williamson 41
Call-D-Cal 52
Candee 61
Central 7
Clegg 1
Clark, Jim 62
Columbia 51
Curta 63
Dale 55
Eico 10
Excello 53
Fulton 59
Gidgets & Gadgets 63
Globe Industries 59
Gonset .... Cover II
Graham 54
Ham-Swap 54
Hi-Par 43
International Crystal 4, 5
Kaufman 55
L-R 63
L-W 55
Lafayette 9
National .... Cover IV
Neil 45
Petersen .... Cover III
Radio Bookshop 60
RTTA 61
Rex 54
Rider, John 8
Shorecrest 62
Spera 62
Stellar 47
Subscription to 73 58
Telrex 51
Texas Crystal 49
Western Radio (San Diego) 57
Western Radio (Nebraska) 62
73 Subscription 58

SIDEBANDER. Official organ of the Single Sideband Amateur Radio Association, 12 Elm Street, Lynbrook, L. I., N. Y. Subs include membership to SSBARA: $3 per year. Monthly. Primarily operating news and chit-chat for the SSB DX gang.

THE MONITOR. Mar-Jax Publishers, 507 West Davis Street, Dallas 8, Texas. $1 a year, 3 years for $2.50. Monthly. Largely operating news. Columns: YL, Club Meetings, Arkansas News, Mississippi News, Florida News, DX, Missouri News, MARS, California News, Louisiana News, VHF News, Oklahoma News, Rio Grande Valley News, Novice News.

VHF AMATEUR. 67 Russell Avenue, Rahway, New Jersey. $3 year. Monthly. Operating news for VHF men. Some technical info.

DX-QSL News Letter. Clif Evans, K6BX, Box 385, Bonita, California. Published quarterly. 40¢ each; Annual subscription $1.25 (four copies) by first class mail ($1.50 for DX stations). Lists all QSL Bureaus, managers for rare DX stations, etc. Why not send your old Callbook to a DX ham? Write Clif for the name of someone who needs it.

DIRECTORY OF CERTIFICATES AND AWARDS. Clif Evans, K6BX, Box 385, Bonita, Cal. Complete Directory plus one year of revisions (quarterly) $3.50. Add 75¢ for 1st class mail; $1.25 for airmail; DX stations 1st class mail add $1.00. Needless to say, this is the most complete collection of data on the hundreds of certificates and awards available.

MOBILE NEWS. Published monthly by the Amateur Radio Mobile Society, 79 Murchison Rd., Leyton, E. 10, England. Joining fee and 1 year sub. is $2.50.

DX BULLETIN. Don Chesser W4KVX, RFD 1, Burlington, Kentucky. DX news in depth. Published weekly. 3rd Class mail $5 year; 1st class $6; Airmail $7.50. DX rates on request.

WESTERN RADIO AMATEUR. Don Williamson W6JRE, 10517 Haverly Street, El Monte, California. Monthly. Subs are $2 per year, $3.50 for two years, $5 for three years. Operating news of west coast activity, columns on DX, SSB, YL, and some articles. 48 pages.

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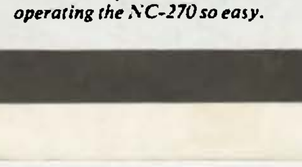

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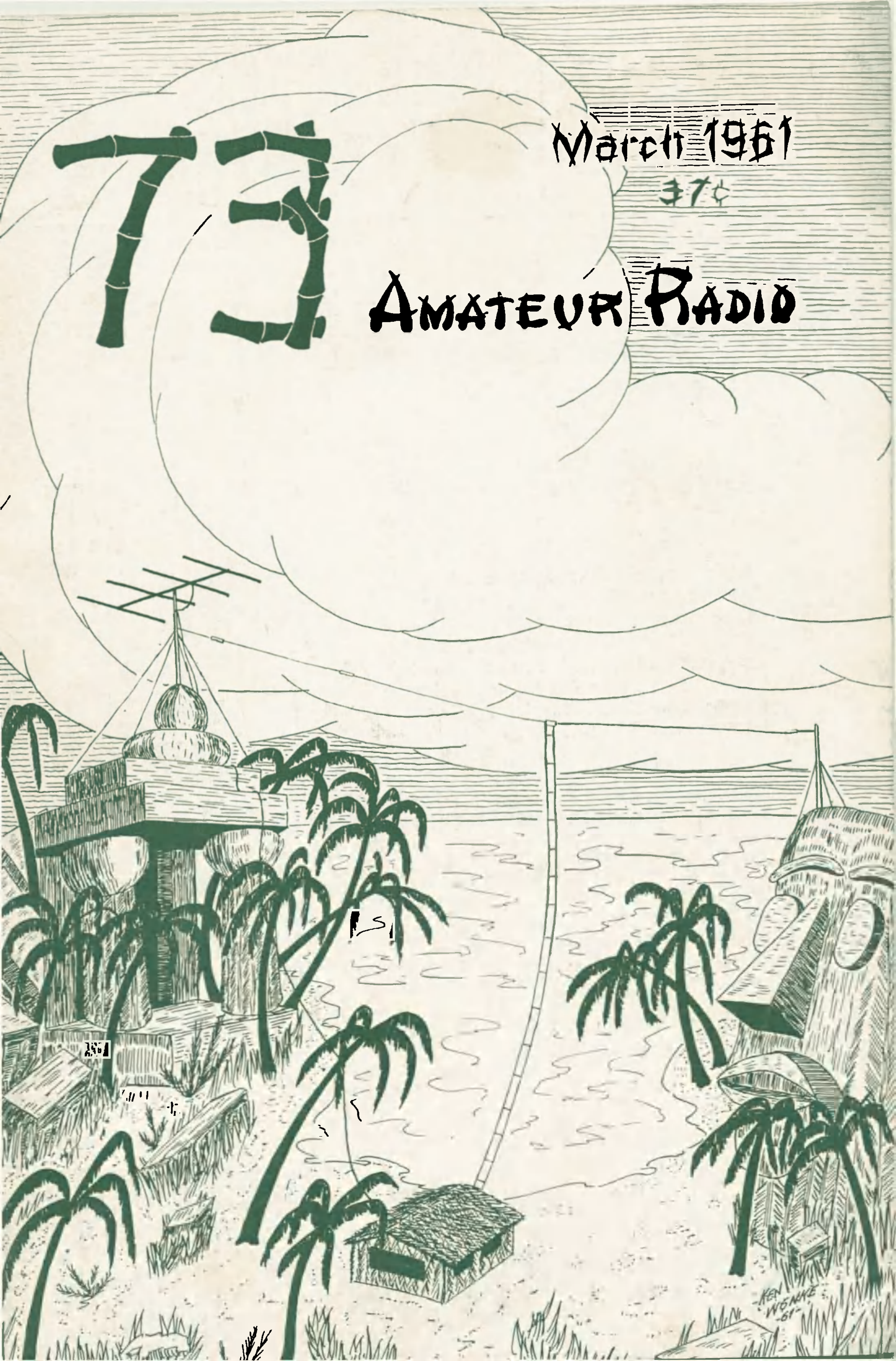
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Table of Contents

March, 1961
Vol. 1, No. 6

Translating Technical Journals .... Jim Kyle K5JKX/6 9
You'll read this one to anyone who will listen.
Transistorized Grid Dip Oscillator .... Melvin Liebowitz W3KET 10
Severing the ac umbilical cord with a transistor.
Curing Ignition Interference .... Charles Schecter W8UCG 13
Step-by-step assassination of the noisy car gremlins.
Superregenrative Receivers .... Howard Burgess W5WGF 14
Ten rules for getting good results from a super-regen . . . illustrated.
Decreasing Debugging Time .... J. Kyle K5JKX/6 16
How to get things back east when they go west . . . in a hurry.
Top Loaded Whip .... Al Newland W2IHW 18
Why not make your own mobile whip?
CW Transmission with Teletype Equipment .... Roy E. Pafenberg 20
Simple conversion of RTTY for that hated CW identification by TT tape.
All Band Antenna .... Kyle K5JKX/6 22
You've been wating for someone to adapt that Log Periodic Antenna.
Double Your Power Supply Voltage .... Charles Spitz W4API 24
Not difficult with a couple silicon rectifiers.
Impedances of Surplus Equipment .... Roy Pafenberg 25
Input and output impedances for most popular surplus gear.
Patch Patch .... Allie C. Peed K2DHA 26
Quick method of hooking your phone patch in and out of the telephone line.
432 mc Transistorized Converter .... J. Specialny W3HIX 27
Good night! How high will they go with transistors? Crystal controlled too.
Two Meter Transmitter .... John Sury K8NIC/5 29
Slight modification of the 6M rig from October issue of 73.
Squawk Box K5JKX/6 30
Transistorized loudspeaker amplifier.
Up Front .... Staff 32
Rather thorough look at receiver front ends, our big technical article.
Don't Bug Me Dad .... Ken Johnson W6NKE 38
Our cover artist also writes. Instructions for new bug owners.
Varicap Tuning Device .... Robert Baird W7CSD 42
Helps the blind ham to tune up his rig . . . or anyone else for that matter.
Noise Clipper, Semiconductor Style .... Al Newland W2IHW 43
Tiny clipper for insertion in car radios, including transistor sets.
Working 80 Meter Phone DX .... Fred Collins W1FRR 44
WAC in one night when you know where to listen.
DC Transistorized Meter Amplifier .... Roy McCarthy K6EAW 46
Get amazing sensitivity out of normal meters with this amplifier.
Motorola Test Set .... Beryl Dassow W9HKA 48
Ham-banding the old Motorola mobile transceivers is popular, this helps.
Propagation Charts for March .... Dave Brown K2IGY 54
What time to where, when . . . probably.
Names, Sines and Handles .... Howard Pyle W7OE 56
Why "YB" calls himself "YB."
Save, Learn, Have Fun .... Hartland Smith W8VVD 62
It really is cheaper to build than buy.
How To File Your QSO's .... John Velamo OH2YV 68
More ideas on card files for contacts.

Misc.:

Table of Contents 3
Editorial..de W2NSD 4
Letters to the editor 6
Advertising Rates for 73 6
Grounded Grid Triode Circuit 12
How to draw a parabola for VHF antennas 15
Plugs for the asking 19
Cut Out vote for articles 43
Air Force MARS Technical Broadcasts 49
Ham Headlines 49
Chassis mounting the PL-259 50
New Products 51
Subscription Plea 55
Other Ham Publications 58
Don't talk to these countries 67
Advertiser's Index 70
Tune Up With A Solar Battery 71

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. . . de W2NSD

(never say die)

Here is the sixth issue of 73. We're still around, still bringing you good articles and lots of 'em . . . plus eight more pages, thanks to the advertisers. Our original policies are still fairly intact. We're still not mad at anybody. Disgusted maybe, but not mad. We've been bringing you the promised technical and construction articles and, if the mail is to be believed, a lot of fellows have started building home-brew gear as a result.

Your Cautious Editor

Unfortunately for my piece of mind I am mis- or ill-informed on many subjects other than ham radio. This manifests itself, as with most would-be writers, in an ambition to write on these subjects. In an attempt to keep from lousing up this otherwise (possibly) interesting pamphlet with such drivel as might erupt when I attempt to over-compensate for a well developed inferiority complex, but still to provide a limited outlet for these psychic disturbances, I will channel my creative (?) energies to the office Ditto machine.

The point is this: if anyone is interested or morbidly curious enough to take the time and send a stamped self addressed envelope then I'll stuff some of my stuff and return it. Look what you get for 4c! All sorts of non-radio (usually) chatter on subjects you'd rather not read about and are sure to violently disagree with, stuff which I'd be out of my mind to publish in 73. Consolation: only one side of the paper will be used so you can tear the pages up and use the back for notes.

RTTY Dinner, March 20th

The Sixth Annual RTTY Dinner and General Conflab will be held Monday evening March 20th at the White Turkey Town House, 260 Madison Avenue (at 39th Street) in New York. The gathering commences at 5 pm, dinner at 7. Formalities will be interesting and brief. Reservations are extremely important this time: send $6.00 to Elston Swanson, c/o Instruments for Industry, 101 New South Road, Hicksville, L. I., N. Y. Please make your reservation as soon as possible.

New York Sideband Dinner

Ten years ago a small group of amateurs held a clandestine meeting during the heighth of the I.R.E. show. The way was hard for the Sideband pioneers and they needed to encourage each other . . . and perhaps they wanted to hear what someone's voice sounded like without the phasing rig between them.

This cautious gathering of avant-garde amateurs has now grown to a full fledged hamfest, complete with displays by manufacturers and a huge banquet at the Statler-Hilton. Send $10 for your ticket to the 10th Annual SSB Dinner to the SSBARA, c/o Mike Le Vine WA2BLH, 33 Allen Road, Rockville Centre, L. I., N. Y. 10 a.m. March 21st at the Statler-Hilton, with dinner at 7:30. Naturally 73 will have a booth.

Phoenix, May 26-29

The Southwestern Division ARRL Convention is girding itself for a real whingding affair over the long Memorial Day weekend. This should be one of the best Conventions in the western U. S. this year, so how about all you Southern Californians buzzing on over for a real western holiday. It may be a bit of a damper, but I'll be there wearing my western outfit. To make up for this we will also have on display our entire subscription department (see December cover.) This isn't enough? We'll also have on display our western representative Jim Morrissett WA6EXU, formerly Assistant Editor of CQ and foreign correspondent on "Frozen Jim" trip to Antarctica.

There will, fortunately, be a lot more interesting things than a vacationing 73 staff to look at. Like they will have prizes: a Viking Kilowatt & Ranger, an SSB station, a tower, a VHF tranciever, and scads of other goodies. Be sure to bring at least a station wagon so you can cart all that stuff home afterwards.

Registration is $8½ per. Send for info or send dough to George Mezey K7NIY, P.O. Box 814, Sun City, Arizona. This includes registration, the big banquet, and a breakfast.

Swampscott

Being only in the throws of preliminary organization and planning of 73 magazine last year at the time of the now historic Swampscott Convention, I unfortunately missed out on it. That is a blunder that I don't intend to duplicate this year. Possibly, for some reason of your own, you also missed this event last year . . . if so it would seem prudent for you to correct this error, if you are within driving distance.

There sure must have been a vacuum on the ham bands in the first district last year

with 3500 hams were off the air all at once. Imagine the poor guy with the little DX-35. He gets on the air on 20 and calls a CQ. Suddenly there are stations calling him from all over . . . he's the only W1 on the band! He doesn't know this is because everyone else is jazzing it up down in Swampscott, all he knows is that everyone is calling him and he is the loudest W1 on the band. This is an evening he'll never forget.

The other 3500 are having an evening they'll never forget too. Decide now which it will be for you: the Convention or lots of DX all to yourself. Write Radio Convention, 15 MacArthur Blvd., Danvers, Mass., for registration forms which are good until March 25th. The Convention is April 8-9, two days.

73 will be there, complete with the Subscription Department. Virginia wants to know if anyone will volunteer to help her keep eager subscribers orderly? . . . W2NSD

LETTERS

Dear Wayne:

The Microwave Society of Long Beach has just been formed and club meetings are held on the second Wednesday of each month at the Bayshore Public Library, 2nd Street and Bayshore Avenue, Long Beach at 8 p.m. We have plans for construction projects that you might be able to use in 73. Can you put this in 73?

Ralph Steinberg K6GKX

No.

Dear Sir:

I saw one issue and I think you have something there. What we need is more technical and construction projects and less ads. We can get all the catalogs we want for nothing. We don't have to subscribe to them. Hi. Hi.

. . . Leo Masterson W3IXO

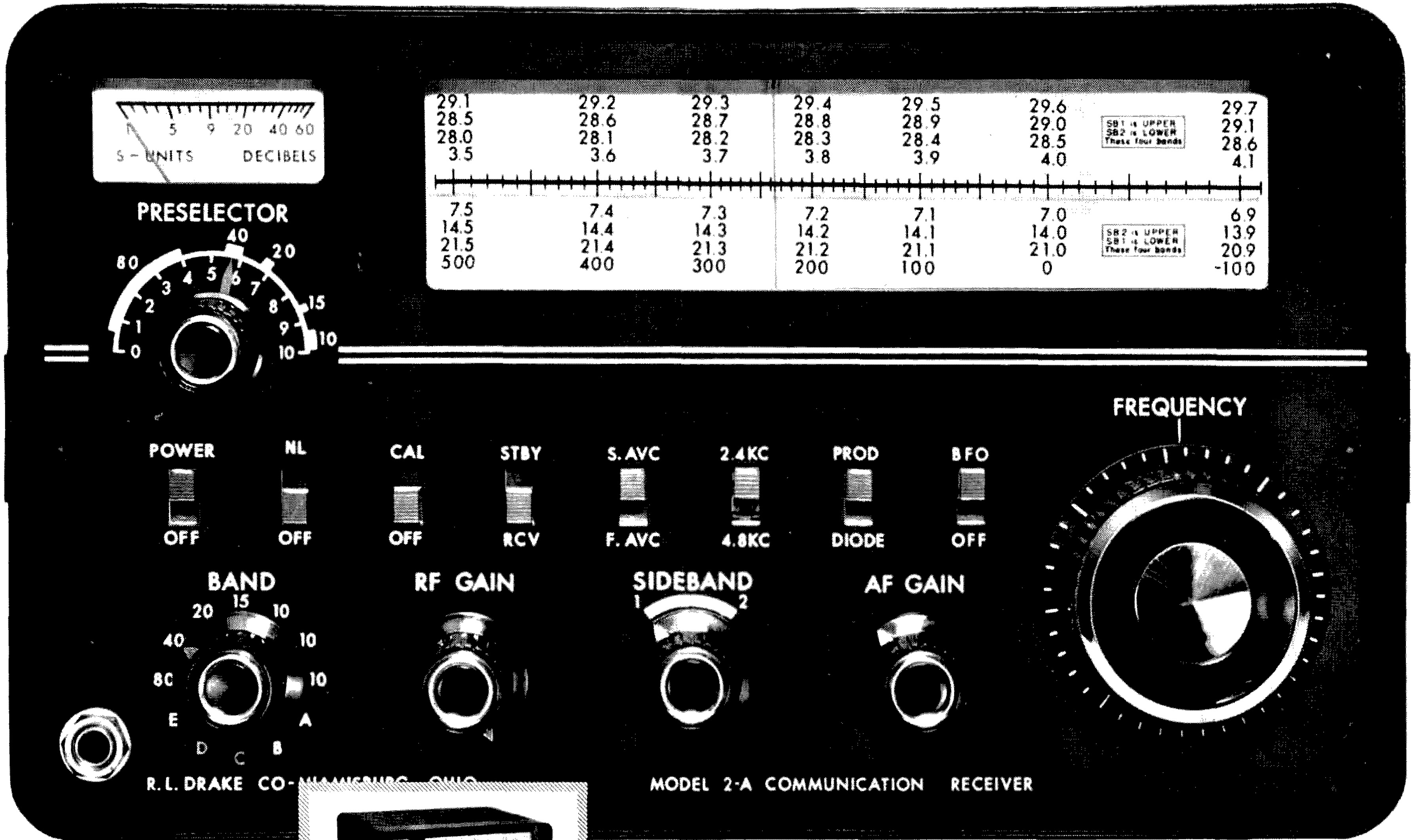
It is refreshing to find such naiveté at this late date. I wonder how fast Leo would rush in his subscription to 73 if he had to send in $10 a year? This is what it would have to cost without the ads. It costs us over 50¢ per copy to produce the magazine at its present size! No, Leo . . . you look carefully at the ads and thank each one for their co-operation in bringing you this magazine . . . without them it would be impossible to publish any ham magazines.

Advertising Rates

There are probably hundreds of likely advertising prospects that we haven't contacted. Since our rates are so ridiculously low it might just be clever to unveil what remaining shrouds of secrecy there are about them. They'll be going up shortly anyway. Note that our 1" ads are only $12 on a 12X basis, making it a fine deal for smaller companies that want to keep their name alive.

1 page	$120	¼ page	$40 (4")
½ page	70	⅛ page	25 (2")
		1/16 Page	$15 (1")

Frequency discount: 6X—10%; 12X—20%. Closing date: 5th of the previous month.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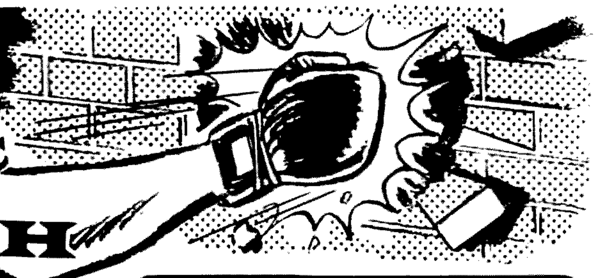

ANNOUNCES

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How To Read What the PhD Writes

Handy Translator for Scholarly Publications

Jim Kyle, K5JKX/6

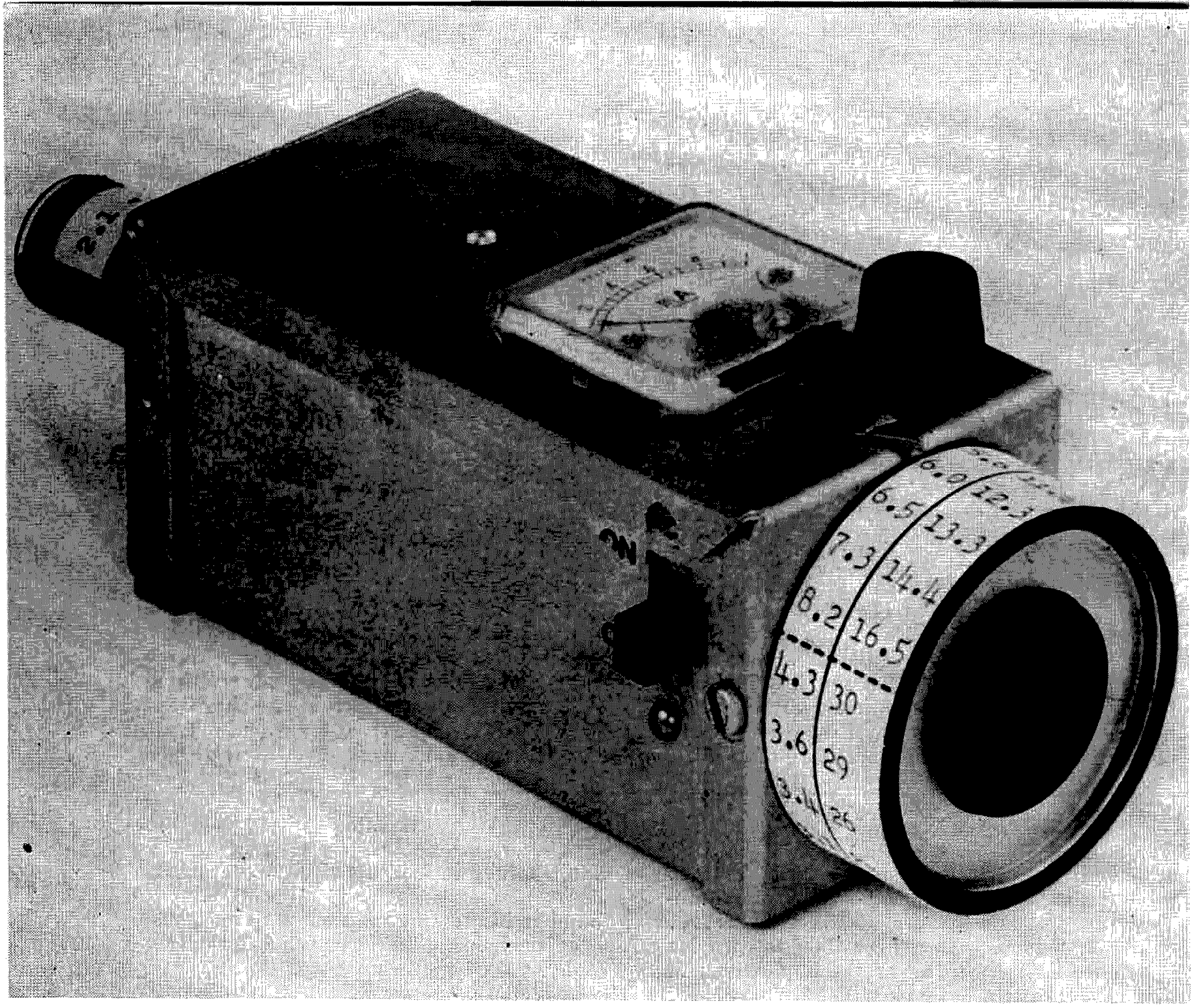
WHAT with the rapid advances being made by the commercial boys these days, not to mention the research carried on by government-sponsored laboratories, the ham who wants to keep ahead of the game almost has to read several of the "Scholarly Publications" devoted to electronics at the design-engineering level.

However, these people have a language all their own—or at least that's the way it seems to the tyro braving the thin air of the high-level research report for the first time. Translating this language into ordinary ham-style English is one of the fine points of the preparation of 73.

But, since many of us like to keep even farther ahead of the game than is possible within the covers of just one magazine—even so chock-full-o'-content a publication as this —we're about to open our top-secret file and provide you a Guidebook to the High-Level Report. With it, you can at least find out what the engineer meant to say. Ready? Here goes:

As Written	Meaning
It is common knowledge in the field	I didn't bother to look up all my references.
. . . of extreme theoretical and practical importance	I found it interesting, you should too.
While it has not been possible to provide definite answers to all of these questions ..	The experiments didn't work, but I thought I could at least get a write-up.
. . . on as broad a basis as possible	The budget was slim.
. . . steps are being taken	I'm trying to convince the boss we need more money.
. . . requires computational facilities of considerable complexity	Where's another box of scratch pads?
Reasonably stable signal	You can track it with the tuning knob if you're fast.
Ultra-stable signal	You don't have to track it.
Extremely precise signal	See "reasonably stable signal."
. . . presently under study	We talk about it at coffee time.
It is suggested that	I think.
It is generally believed	A couple of other guys think so too.
Within an order of magnitude	Between a tenth and ten times what I said it was.
Typical results are shown	The best results are shown.
. . . well below	Greater than ....
. . . surprisingly low error	Something's wrong—it agreed with my calculations!
. . . to a first approximation	to a random guess.
. . . introducing the constant factor B	By introducing B, I can solve the equation. Any other way, it doesn't make sense.
. . . optimum performance was achieved with the circuit shown	This circuit worked. All the rest failed.
. . . appears entirely practical for our use	Hams have been doing it for years, why can't we?
It is to be hoped that this effort will stimulate additional research	I still don't understand it, and neither does anyone else I could locate. Won't somebody please try it too and explain it to us?

. . . K5JKX/6



Grid Dip Meter,

Transistorized,

Improved

Melvin Leibowitz, W3KET
220 West Fourth Street
Wilmington 1, Delaware

THE grid dip meter is probably the most useful piece of test equipment available to the ham. Battery operation is desirable for several reasons:

1. The instrument may be used outdoors for antenna work.
2. Lack of "warm-up" time.
3. No trailing cord to get in the way.

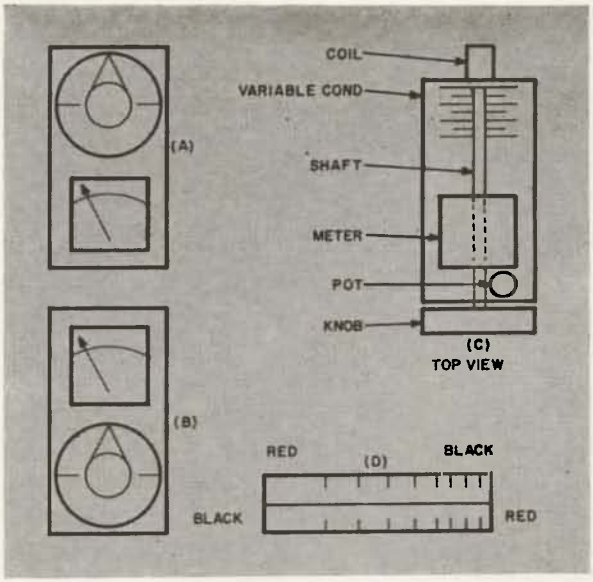
If the instrument is to be battery operated it should be transistorized for maximum battery economy and light weight. Such grid dippers have appeared in ham literature [1, 2] but they have several common faults:

1. The mechanical design is difficult for the average ham to duplicate.
2. Calibration scales are hard to make and look sloppy unless the constructer is a skilled draftsman.
3. The coil forms are usually required to have more than two contacts. This dictates the use of an Amphenol series 24 coil form and socket. These forms do not lend themselves to quick and easy changing which is highly desirable.
4. The usual design is awkward to hold and use. Consider the design shown in Fig. A with the dial at the top of the instrument and the meter below it. This type is easy to make but unfortunately the user's arm obscures the meter when turning the dial. The dial might be placed below the meter as in Fig. B. This results in long leads between the coil and condenser and is undesirable. Commercial instruments get around this problem by bringing the rim of the tuning dial out the side of the case. This type of instrument is difficult to hold, build, and calibrate.

The type of construction shown in the photograph and Figure C eliminates all of the above problems. The condenser is located close to the coil and is turned by an extension shaft coming out the end of the box. The instrument is comfortable to hold. The only metal fabrication involved is a simple "L" mounting bracket for the variable condenser. The calibration scale is a flat strip of paper glued to the rim of a *National* HRT knob. Since the calibration marks are on a straight line they can be typed in on an ordinary typewriter for neatness.

Sharp eyed readers will note the use of *Amphenol* series 24 coil forms which I have previously condemned. The electrical circuit has been revised so that only two pins are needed on the coil form. The unused contacts are removed from the coil socket. This reduces the friction considerably and the coils are easy to change yet a good electrical contact is still maintained.

The oscillators shown in previous articles employ the unused pins on the coil form to vary the bias on the transistor as the frequency is raised. Since we have limited ourselves to only 2 pins we cannot use this approach and a potentiometer has been substituted for the fixed resistors. This produced a bonus in that it is possible to set the pot for relatively weak oscillations. Under such conditions the meter will give a good dip with very loose coupling to the tuned circuit.



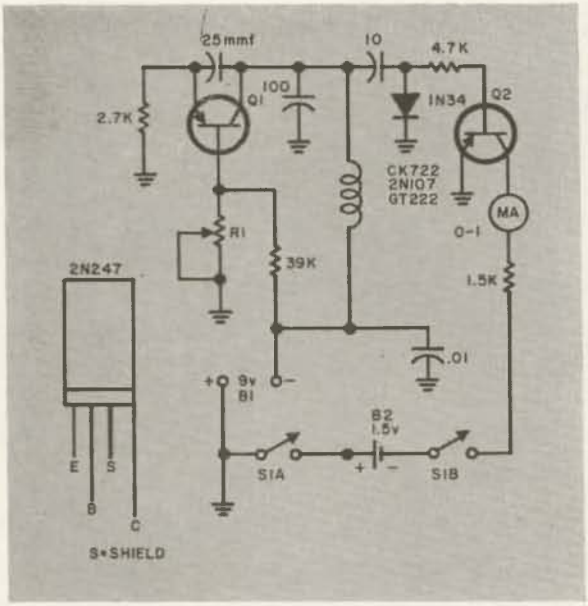
Most of the constructional details should be evident from the photographs, except for the mounting of the *Amphenol* 78S5S coil socket. This socket is designed to be mounted by means of a retaining spring. This does not give a good solid mount. Obtain a top mounting, bakelite, 9 pin miniature tube socket. Crumble the bakelite part by squeezing it in a vise. The object here is to free the metal mounting ring so that it can be used to mount the coil socket. File 2 round notches in the coil socket so that the retaining ring will slip over the socket from the top. The socket may now be bolted to the chassis just like any other socket. Place two or three small washers under the ears of the mounting ring to make up for the difference in thickness of the ring and socket. Remove all but two of the contacts from the socket before mounting it in the chassis.

The unused contacts are removed by bending them with a pair of fine-nose pliers until they break off. The contacts inside the socket will then fall out. Sub-miniature tie points are mounted on each of the meter terminals to aid in point-to-point wiring.

The meter will oscillate readily up to approximately 35 megacycles using a 2N247 transistor. Use a 2N384 in place of the 2N247 if the six meter band is desired.

Calibration

Calibration is divided into four overlapping ranges. Two of the ranges occupy 180 degrees of the dial. The scales may be typed on a typewriter as already mentioned. It is prefer-



able to use a two color ribbon such as a red and black. This will help to separate the scales. The finished calibration will then look like that in Figure D. Cut a sheet of good quality paper the same width as the rim of the knob and long enough to go around the rim with about a half inch overlap. Attach one end of the strip to the knob by means of Scotch tape. Wrap the strip around the knob and hold it in place with a rubber band. Calibration is most easily accomplished by listening to the oscillator on a continuous coverage receiver. As each point is found, mark the paper with a light pencil mark. Pencil in lightly the frequency for each park to avoid confusion. After all calibration points have been found, transfer the paper to the typewriter and type in the figures. The lines may be inked in with India ink or a ball point pen. Erase the pencil marks with a soft eraser and re-attach the paper to the rim of the dial using a piece of Scotch tape. Wind the scale around the dial just as before except this time anchor the free end of the scale with tape. Continue winding the tape completely around the scale being careful to avoid wrinkling the tape. The tape will protect the scale against wear and soiling. Tune a receiver to one of the calibration frequencies, insert the appropriate coil in the dipper and set the dial to aforesaid calibration frequency. Loosen the set screw in the shaft coupler between the variable condenser and knob shaft. Rotate the variable condenser until the oscillator is heard in the receiver. Tighten the set screw and the job is done.

Operation

The various applications of the dipper are well known and will not be repeated here. The transistorized dipper should not be used as an absorbtion wavemeter as the transistor will likely be damaged due to excessive rf. In use, the pot is set so that the meter reads half scale or slightly less. The meter is most sensitive at this point. The actual setting of the pot will vary with the different frequency bands covered. Do not allow the meter to read more than half scale as it will be difficult to get a dip under such conditions. . . . W3KET

1. Radio Amateurs' Handbook; 37th. Edition page 520.
2. CQ: page 56, Sept. 1958.

Parts List

Q1—2N247 or 2N384 (see text).
Q2—Any PNP transistor that works (not critical).
B1—Burgess 2U6.
B2—Burgess N or NE (if type N is used, wrap in insulating tape). Slab Double pole single throw slide switch.
R1—10K subminiature pot, Philmore #PC51.
Cabinet—LMB #TF778, 2 1/4 x 2 1/4 x 5.
Ma. 1 1/2" 0-1 Ma. DC

Coil Chart

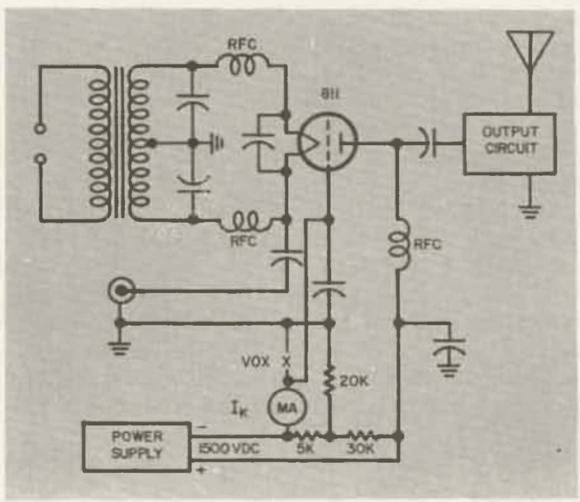
Band	Frequency (mc)	Turns
1	2.1- 4.3	63
2	4.3- 8.6	24
3	8.6-17.2	9
4	17.0-31.4	4

All coils except #4 close wound on 3/4" form (Amphenol 24-5H).

#4 spaced diameter of wire.
#28 D.C.C. used for all coils.

SHORT ITEM

HERE is a circuit which may be of general interest. It has been built into several rigs here and has been proven quite satisfactory. Its theory of operation is quite simple. In standby position the zero bias triode sees blocking bias across the 5K portion of the bleeder, the cathode seeing the positive end of the 5K resistor through the 20K resistor. In transmit position the grid is grounded by the VOX relay resulting in a simple grounded grid circuit.



Robert Lile K6QGE, WA6LFD
Jr. Eng., Jennings Radio Mfg. Corp.

Eliminating Ignition Interference

Chuck Schecter W8UCG
630 Glenwood
Muskegon, Mich.

THE following instructions represent the most common cures for mobile interference to radio reception. These instructions apply to all frequencies from the Broadcast band through the Very High Frequencies and include Amateur, Commercial and Citizens Radio Services. Every possible source of noise is not necessarily covered in detail. It is suggested that each step be followed in the sequence shown—stopping whenever the interference has been reduced to a satisfactory level. Steps 1, 2 and 3 generally provide about 80% noise reduction.

1. **GENERATOR**—Install a Sprague 48P18 coaxial condenser in series with the wire on the "A" (Armature) terminal and fasten the mounting bracket securely to the generator frame. See diagram. A clean commutator and good brushes are also important.

2. **SPARK PLUGS**—"Resistor" plugs are the first choice and are the most effective. They should, of course, be kept properly "gapped." Second choice would be a *good grade* of suppressor—5,000 ohms for each plug and 10,000 ohms for the distributor "hot" lead. Engine performance is NOT affected. Also check the metal "tips" on EACH END of the coil and plug wires to be sure that there are NO "gaps" here! Clean and solder these wires to the tips.

3. **VOLTAGE REGULATOR** — Install one Sprague 48P18 in series with the wire on the "A" (Armature) terminal and also one of the same in series with the wire on the "B" (battery) terminal of the regulator. See diagram. Secure the mounting bracket to a good "ground" on the body CLOSE to the regulator. Install a 3.9 ohm, 1 watt carbon resistor with one end connected to the "F" (Field) terminal of the regulator and the other end connected to one of the wire leads of a Sprague 46P12 coaxial condenser. Clip off the other wire lead of this condenser and secure the mounting bracket to a nearby body "ground." See diagram.

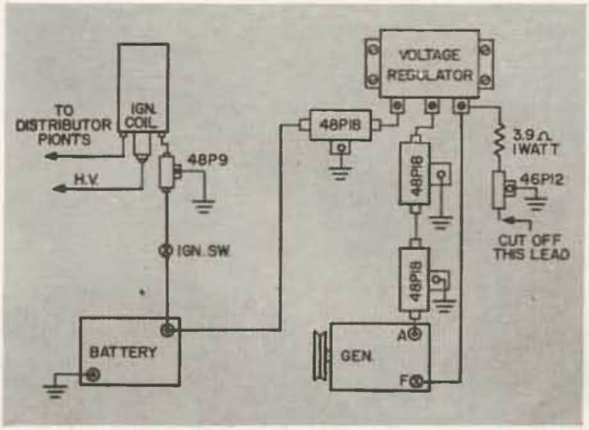
4. **COIL**—Install a Sprague 48P9 coaxial condenser in series with the coil primary *battery* lead *at the coil* and ground the mounting bracket at a *nearby* point. See diagram.

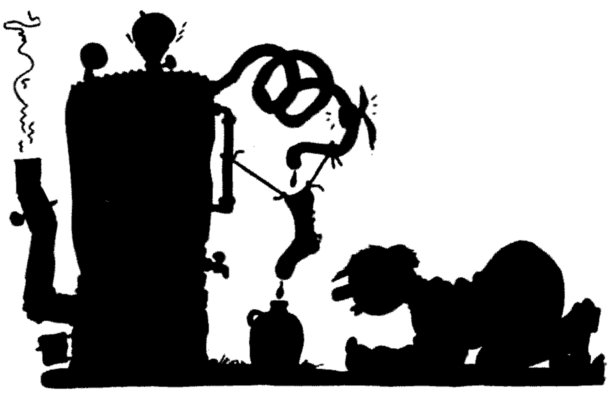
5. **BONDING**—Additional noises are often eliminated by "bonding" various portions of the vehicle together by means of a flexible tinned-copper bonding braid such as Belden 8668 and 8662. Use the 8668 to "bond" choke, temperature and control cables to the body or frame *where they pass through the firewall.* Use heavy-duty braid 8662 to bond the exhaust pipe, muffler, steering column, engine block and firewall to the car frame.

6. **GAUGES**—The gas, oil, heat and other gauges can be checked for noise by disconnecting temporarily. Any noise generated may be eliminated by installing a Sprague 48P9 in series with the "hot" lead of the offending gauge AT THE GAUGE.

7. **WHEELS AND TIRES**—Wheel noise may be eliminated by installing special spring-type static collectors in the front wheel bearing caps. Tire noise may be eliminated by injecting a special graphite powder into the tires with a special injector.

It will very seldom be necessary to complete *all* of the above and generally satisfactory radio reception is obtained after completing as few as one, two or three steps.





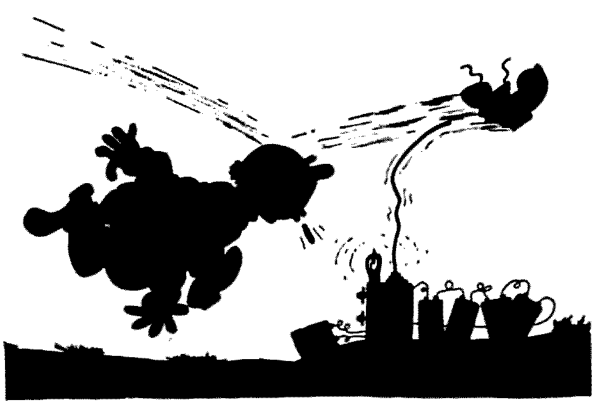
Rule 4. "Use plenty of filtering. . . ."

10 Rules of Thumb for the SUPERREGENERATIVE RECEIVER

Howard F. Burgess, W5WGF
1801 Dorothy Street, N.E.
Albuquerque, New Mexico

THE many new uses for radio receivers, which include the Citizens Radio and paging services, have created a need for small receivers. As a result superregenerative receivers are enjoying a return to popularity. Their high sensitivity and their ability to reject certain types of noise make them very useful when low current drain is important. However the superregenerator is tricky and many of the techniques that help to make a good receiver seem to have been lost since their last peak of popularity. The work of many experimenters can be summed up in a few "rules of thumb" to guide the designer and builder.

1. Operate the superregenerative detector with 30 volts or less on the plate. With modern tubes a well-designed circuit may operate with as low as 4 or 5 volts. By using low plate voltage, interference to other receivers is reduced and sensitivity is often increased.



"Reduce interference with low plate voltage.

Rule 5. "Use cheap transformers. . . ."

2. Avoid using a tuned amplifier stage ahead of a superregen detector if it is tuned to the same frequency as the detector. Instability will usually result. Try using an untuned grounded grid stage.
3. Use a low quench frequency (10 kc to 20 kc) for improved selectivity. A higher quench frequency will give better audio quality and greater sensitivity. However, a high quench frequency may cause multiple spot tuning.
4. Use plenty of filtering to remove the quench frequency from the audio output of the detector. The first audio stage on many receivers is overdriven with a quench voltage that is above audibility. This will reduce the effectiveness of the receiver.
5. If it is practical, use an audio transformer to couple the detector to the first audio stage. Usually the cheaper the transformer the better, as a poor transformer will pass less of the high frequency quench voltage.
6. Use a variable padder for the grid condenser of the detector. This will solve many of the headaches of getting proper operation. This adjustable capacitor will give control of the

Rule 8. "Separate quench requires a few more parts. . . ."

time-constant that determines smooth quenching action in the self-quenched detector.

7. Satisfactory superregeneration becomes increasingly difficult below 4 megacycles. Operation is very good upwards from 10 mc well into the kilomegacycle region.
8. In most cases a separate quench oscillator will prove superior to a self-quenched detector but such a circuit requires a few more parts and adjustments.
9. A superregen will give the best results when tightly coupled to the antenna or preceding stage. If it has been designed to operate on low plate voltage, tight coupling will not cause objectionable radiation.
10. Contrary to popular belief, a good superregenerative detector does not sound like a power saw in a pine knot. When properly adjusted a good detector will have very little more background noise than a superhet receiver.

Rule 9. "Tight coupling helps. . . ."

Of course all rules are made to be broken and a very good receiver can be made by breaking all of the above suggestions . . . but the odds are against you if you insist.

. . . W5WGF

Rule 10. "Contrary to popular belief. . . ."

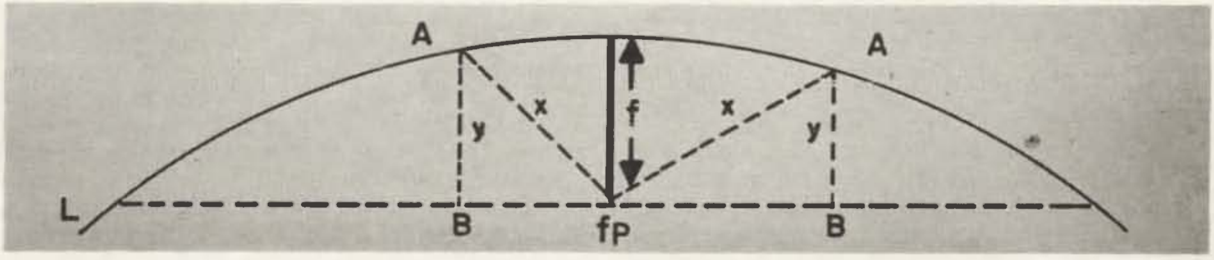
DRAWING A PARABOLA

W7FGG via W9ALU

VHF men, particularly those interested in building antennas for 1296 mc, may be interested in a simple method of drawing an accurate parabolic curve.

When we take the basic idea that in a parabolic curve with the focal point (f) at the mouth of the parabola, the width is 4f and x plus y is always 2f, then we can set up a mechanical method of tracing this curve.

Choose the mouth width you want and draw a line (L). The center of this line will be the focal point (fp). Tie the end of a string which reaches from fp to L to a nail and nail it at fp. The other end can be tied to another nail which you can run along the line fp-L. By letting the string slide around a pencil at point A and keeping y perpendicular to fp-L your pencil will draw a parabolic curve.



D. D. T.*

*Decreasing Debugging Time

Jim Kyle, K5JKX/6
Associate Editor

Anyone who has ever attempted even the simplest bit of homebrew construction undoubtedly has Murphy's Law of the Innate Perversity of Inanimate Objects—"If any item can possibly fail to operate properly, it will!"—committed to memory the hard way. One of the major selling points of factory-built and kit-styled equipment, in fact, is that all design bugs have already been eliminated from it.

Despite the bugs, though, there's a certain satisfaction in homebrewing that no amount of factory-built gear can duplicate. Besides, what else can you do if no one is marketing the kind of equipment you need?

Since every design, by Murphy's Law, will contain a few bugs in unpredictable locations, the happiest way to solve the problem is to establish a procedure for "debugging" each new project as painlessly as possible immediately upon completion. The purpose of this article is to describe such a procedure in a form which can be adapted to any needs.

For the purpose of chasing them down, bugs can be grouped into two major classes: those due to design, and those due to construction practices. Within each of these classes, subdivisions may be established.

Design bugs frequently encountered include oscillation, parasitics, other forms of instability, and overheating of components. All of these may be found in transmitters, receivers, audio equipment, and most other electronic gadgets.

Construction bugs include all of the above, as well as unwanted hum and noise, and spurious signals.

One of the first steps in the debugging process starts before construction commences: a careful review of the planned project to try to detect any possible design trouble areas. Since this step has been adequately covered elsewhere, it will not be described further. For our purposes, debugging will be considered as starting at the completion of construction.

Before applying power to the equipment, a detailed inspection of the finished job is in order. While it's usually hard to wait before turning it on, this inspection can frequently save valuable components from damage if you detect inadvertent wiring mistakes such as having the high-voltage line connected to grid instead of to plate on a 4X250B.

Shake out all the bits of solder and other construction debris after your inspection, but don't turn the gear on yet. Step number two is a point-to-point check, using your ohmmeter. This double-checks your inspection. Test for continuity in all filament and other applicable circuits. Measure resistance from the high-voltage line to ground; this reading should be almost zero initially, increasing rapidly to the value of the power-supply bleeder resistor.

The third step—Stay away from that power switch for a few minutes more!—is to disconnect the high-voltage leads temporarily and connect jumper wires leading outside the chassis. With high voltage circuits broken, you can now turn the equipment on—but be careful to keep clear of the exposed high-voltage leads.

If no smoke pours forth, and all filaments light properly, you're doing fine. At this point you can be reasonably certain that you have made no wiring goofs; you still don't know about all the other possible bugs.

In the next step, you have a choice. The objective is to operate the equipment at reduced plate and screen voltages. You can either connect a heavy-duty resistor of the appropriate value in the external high-voltage jumpers, or you can steal power from a lower-voltage supply in other equipment.

If you steal power elsewhere, be certain that you never apply voltage to the screen of any tube unless plate voltage is applied at the same time. Application of screen voltage only will permanently damage the tube, by permitting excessive screen current flow. You can, however, apply voltage to the plate only if you like without damage.

The value of reduced voltage to use will vary with the equipment being tested and with the availability in your shack of suitable resistors and/or lower-voltage power sources. The best starting point is approximately 50 percent of operating value.

If the equipment under test is a transmitter, be sure to load it with a dummy antenna. Any signals emitted during the test procedure

are sure to be sour, and might earn you a pink ticket if sent into the ether! Besides, FCC regulations call for all tests and adjustments to be made into dummy loads.

At this point, turn on the power. Observe any built-in metering for indications of improper performance (but be sure to make allowance for the departure from design voltages in assessing what constitutes "improper" operation). If all goes well and there's still no smoke, go through the entire planned operating procedure, watching carefully for any signs of parasitics, instability, or overheating.

If neutralization will be required, make the necessary adjustments during this portion of the test. They will have to be touched up later when full voltage is applied, but will be at least in the right ball park at that time.

With everything working properly at this stage, you're ready to cut power, remove the extension jumpers, replace the internal power-supply connections, and try at full operating power.

Test procedure here will be a repeat of that performed at reduced voltage. If you find no troubles, congratulate yourself—you will have produced a virtually bug-free design.

Tests for spurious signals, noise, and frequency instability are best made on the air with assistance of a cooperative friend. Keep in touch with him by landline and make sure your test transmissions are as short as possible. Have him check your signal for all listed faults, as well as anything else he can think of. And make sure he gives you an honest report; it's better to hear the bad news from him than from an Official Observer or, worse yet, an FCC monitor.

So far, we've assumed that the equipment passed every test with flying colors. What if bugs make themselves known?

Existence of the troublesome bugs is easy to detect. Parasitics usually manifest themselves in a transmitter by a buzzing sound, and can be heard on a receiver tuned near the signal frequency. Parasitics in a receiver or an audio amplifier appear as a squawk in the speaker.

Instability in a transmitter appears as a sudden climb in amplifier plate current, as a "wandering dip" in plate circuit tuning, or as a "squeal" in a receiver tuned to signal frequency. Instability in a receiver or an audio amplifier shows up in the speaker.

Frequency drift shows up as a slow movement of the signal when it occurs in a transmitter, and in a receiver is manifested by drift of all signals including broadcast stations and WWV (neither of which drift a detectable amount within a 24-hour period). Overheating is detected visually (by looking for red plates in tubes and for smoke curling up from beneath) and by nose (for the smoke).

Usual causes of these bugs are listed in Table 1. Cures are listed in Table 2.

BUG	USUAL CAUSE
Parasitics	Unwanted resonances in amplifier circuits; Improper time constant in oscillator gridleak circuitry.
Instability	Unwanted regenerative feedback around amplifier stage; Improper shielding of transmitter stages; Stray coupling.
Frequency Drift	Insufficient isolation between oscillator and other circuits; Improper mechanical construction of oscillator; Improper control of oscillator voltages.
Overheating	Wrong connection; Insufficient safety factor in component rating; Loss of grid bias (in tubes); Unbalanced drive (to push-pull tubes); Defective component.

Table 1. Usual Causes of Equipment Bugs

CAUSE	CURE
Unwanted resonance	Install "parasitic trap" tuned to unwanted resonance frequency to trap out energy.
Improper oscillator time constant	Reduce either resistance of grid leak or value of grid capacitor until parasitic disappears.
Unwanted feedback	Isolate input and output of amplifier from each other; decouple power leads.
Improper shielding	Shield each stage, leaving no holes and bypassing all leads which pass through shield plates.
Stray coupling	See both Unwanted Feedback and Improper Shielding.
Insufficient isolation	Install buffer amplifier between oscillator and associated stages.
Improper mechanical construction of osc.	Improve mechanical features of oscillator construction; make sure no component is able to vibrate.
Improper voltage control	Install VR-tube or electronic voltage regulator circuit.

Table 2. Cures for Common Bug Causes

Of course, these brief tables can't list every possible bug which may show up in new gear. However, if your own pet bugs aren't listed, you can usually determine the cause and probable cure by applying a little concentrated thought to the problem, once you know the bug exists.

And by following the procedures described here, as a standing operation upon completion of each item of newly built equipment, you'll be certain that you've located all the bugs at no risk to the equipment or to your reputation with the FCC. Good luck, and happy home-brewing! 73

Top Loaded Whip

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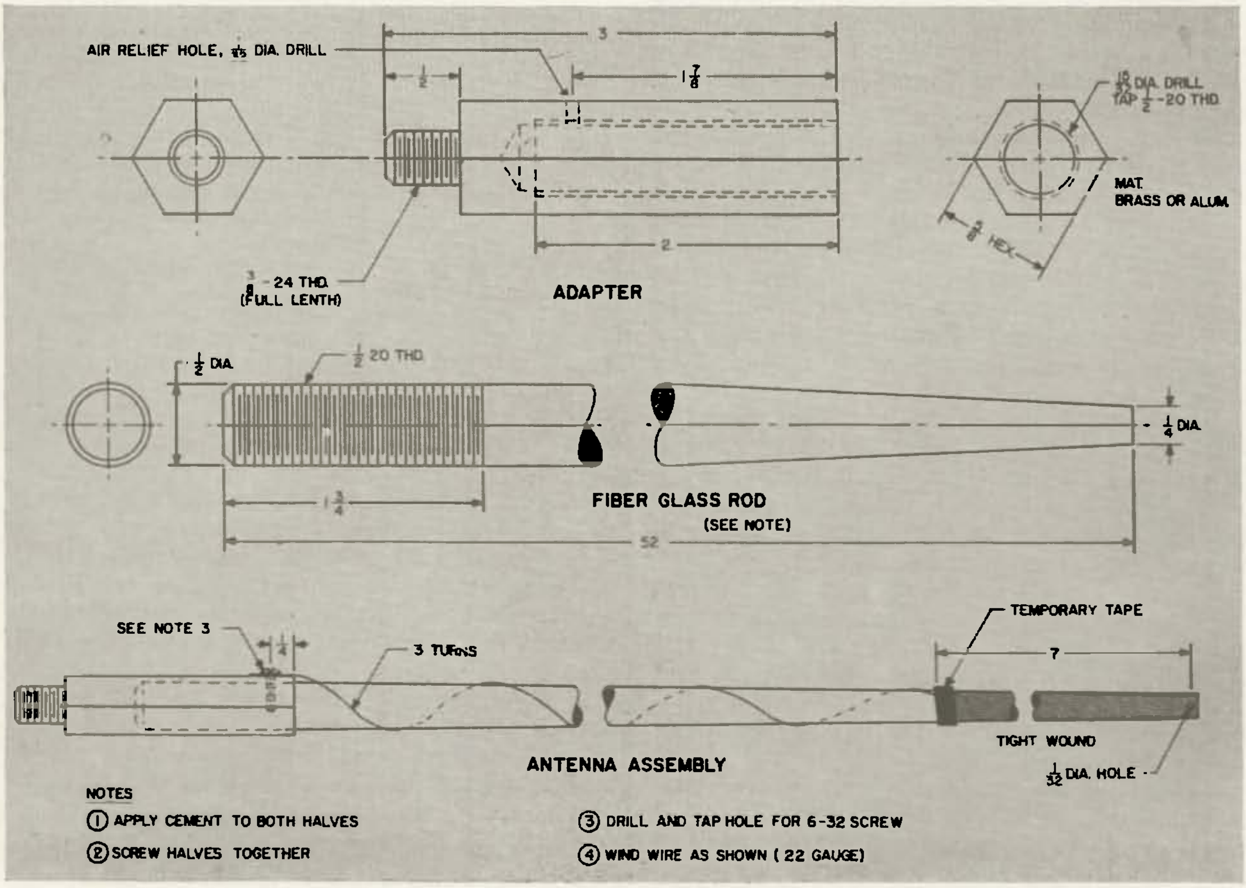
THE interest in short efficient mobile whips is ever increasing. If one can conveniently make his own whip to help cut costs it becomes more interesting. Some added attractiveness lies in the fact that the whips can be selected or cut to the exact length *you* desire. With the proper length to clear your garage door there will be no need to bend it down. If you do not bend it down there will be no need for purchasing a spring or tie down clip. The method of mounting, of course, is quite optional. A method of terminating the fibre-glass rod for attachment to a standard mount is shown in Fig. 1.

If a 52" rod is used (as shown) then a close wound coil 7" long made of No. 22 enameled or Formvar wire is suggested. No pruning of the coil is done on the upper end of the whip so a small hole is drilled as shown to anchor the wire prior to winding. A piece of electronic tape is applied over the last few turns to prevent unraveling and the wire is then extended for the balance of the rod using about a 3 turn spiral. If a rod less than 52" long is used then it will be necessary to start with a longer coil. Scrape insulation from end of wire and fasten securely under screw head. Attach antenna to car and add a jumper wire from the antenna to the car frame as shown in Fig. 2. It is suggested that the coax be removed from the antenna mount when grid dipping.

With an excess of turns in the coil, a frequency somewhat lower than that required for 28 mc will be observed. In order to raise the frequency proceed as follows. Unfasten wire from under screw head, remove turns from the lower end of the coil, pull the wire taut, clip off the excess wire, scrape off the insulation as before and refasten wire under screw head. It will be noted that the dip from this type antenna is quite sharp—so tune carefully.

When the whip has finally been trimmed to

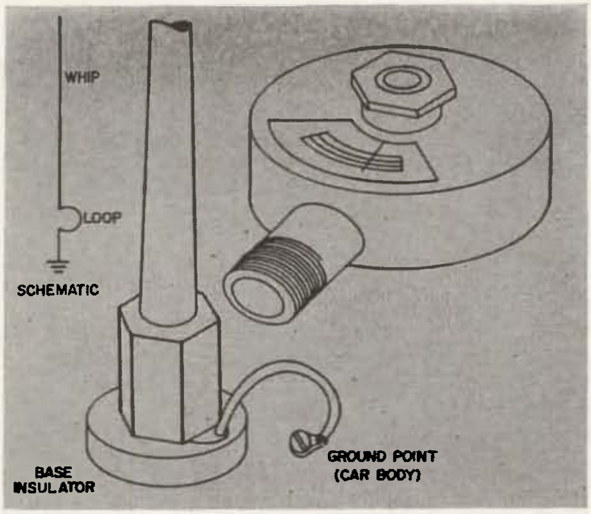


the desired frequency, it will be necessary to coat it with several protective layers of varnish or lacquer. Krylon or lacquer in pressurized cans is very convenient. After the first coat is dried the tape may be removed and the additional coats applied. Allow ample drying time between coats.

The use of this type whip is not limited to 10 meters but may be used on any frequency where a full length is not desirable. A ground plane or beam antenna may be constructed using this type whip. When used on marine equipment, a much neater boat appearance is obtained.

Note: Fibre-glass fishing rod may be purchased from your sports goods store. Available from the writer at $2.00 post paid.

. . . W21HWR



Plugs for the Asking

A short treatise on a fine point in the Scrounge's Art

Staff

ONE major bottleneck in many home construction projects has been location of a convenient octal-base plug which can be fastened to other components.

When just the plug is needed, the old standby, the base of an octal tube, less all glass and cement—works fine. But the plastic base proves difficult, if not impossible, to attach securely to other parts of the project.

There's an easy way out of this problem, though, and it shouldn't cost you much more than a cup of coffee.

It's simply this—transmitting tubes such as the 2E26 and 6146 have a metal-shelled base, made of plated brass, which takes solder perfectly.

If you remove all glass, tube elements and cement from the base of one of these tubes, all you have left is the brass case and a low-loss plug which fits an octal socket—perfect for soldering into a chassis box or flashing copper, and big enough for many receiving accessories to fit right inside.

The only remaining problem is where to locate the tubes. With 6146's going for nearly $5 each, most people are pretty careful about burning them out. Chances are you won't have very many in the junkbox.

But there's a perfect source of supply in virtually any part of the country, if you know where to look. Nine out of 10 commercial two-way rigs such as police, fire, and taxicab radio use either a 2E26 or a 6146 for the final.

Technicians working on these sets must test tubes by substitution, since many of the tubes check out fine on a tester but won't work at 152 mc when they get old. The sour tube goes into the wastebasket.

To find the service shop, check with your sheriff. He's an elected official and usually is friendly to any voter who's civil to him. If you explain what you're looking for—the shop, that is, not the tubes—he'll undoubtedly tell you who works on his radios.

At the shop, try to find the technician in a fairly good mood. This is difficult, and in many cases impossible, since all his customers bring in work which must be delivered yesterday and want it back right now. It's a hard life, as the technician will be only too happy to tell you.

Buy him a cup of coffee—or something stronger, if you and/or he doesn't object (he won't). Sympathize with his troubles. About the time he's thinking you're a friendly sort of fellow, ask him how he ever manages to get rid of the old tubes.

He may prove cagey and think you're trying to put something over on him. Two-way technicians are a nervous breed. But you can prove to him you're not trying to sneak a free tube by bashing the glass out of two or three and telling him you'll be glad to take the remnants away.

Odds are you'll go home with enough weak and dead tubes to keep you in business for months. Who knows, you may even find a job servicing two-way!

And in case he doesn't make you break all the tubes, it will never hurt to run them through a checker somewhere before smashing them.

Most of the tubes which fail in this service still have plenty of life left for frequencies below about 80 mc, and all of them that aren't broken, gassy or burned out have enough poop left to make fine modulator tubes.

So you can get the free tubes, as well as the tube bases you went after. Just don't let the service man know. You may want some more some time.

CW Transmission with Teletype Equipment

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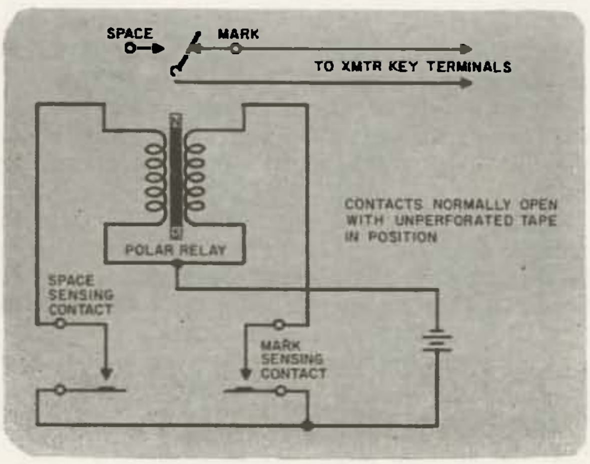
RADIO amateurs in general and many actively engaged in the communications field are apparently not aware that perfect CW code transmission is possible with standard Teletype tape equipment. At the risk of boring the avid RTT amateur, a brief review of basic Teletype theory will be helpful in understanding the method used.

The standard American Teletype code consists of the presence or absence of a total of five code impulses. The teletypewriter keyboard sets up the combination appropriate to the key depressed and this information is sequentially read out by the internal mechanism of the machine and transmitted as a series of electrical impulses. Added to the actual code are the start and stop impulses which are used to effect synchronization between the sending and receiving equipments.

Actual keyboard to page printer communication is rarely used for the passing of traffic for several reasons. Leased communications channels are quite expensive and are usually obtained on a scheduled or call up basis. Since few operators are capable of sustained, error-free operation at the maximum rate of transmission that the system allows, it is more economical to store the traffic in the form of manually perforated paper tape. Then, as circuit time becomes available, the tapes are transmitted by a special tape reading device known as a transmitter distributor or, as it is commonly known, a TD. Tape preparation is accomplished by a perforator which is electro-mechanically linked to the Teletype keyboard or by a reperforator which accepts Teletype signals and simultaneously punches and prints the intelligence on the tape.



The prepared tape has a total of six rows of perforations, five of which constitute the five element Teletype code. The sixth row engages a sprocket in the tape head and is used to advance the tape. The tape head has five sensing pins, one for each element of the code. These pins are linked to associated contacts which close if a tape perforation is sensed. Once the code combination is sensed by the tape head, the distributor sequentially reads out this information. In addition, the distributor adds a space impulse at the beginning and a mark impulse at the end of the code combination. The tape is automatically advanced one set of holes and the distributor makes one read out revolution at a fixed rate of 368 times per minute. This results in a nominal rate of transmission of 60 words per minute.

Enough for Teletype theory and now a look at the construction of International Morse Code. The dot is the basic element of this code and the dash is three times as long as the dot. An interval equal to one dot separates dots and dashes within a character, an interval equal to three dots separates characters within a word and an interval equal to five dots separates words.

By arbitrarily selecting the presence of one element of the Teletype code as a key closed condition and its absence as a key open condition, it would appear possible to form CW characters by punching a series of characters that contain this element for key closed condition and a series of characters that do not

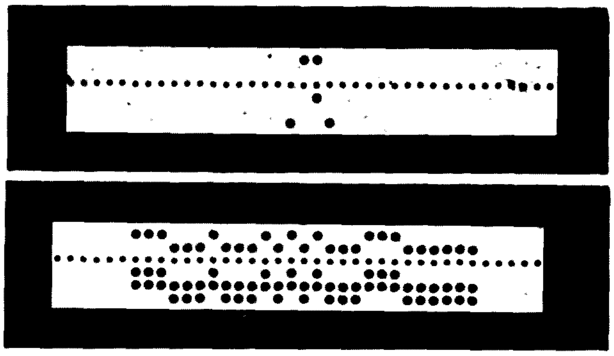
contain this element for key open condition. Dot duration would be one machine operation or 1/368 minute. This is feasible if two additional conditions are met. First, the contact associated with the code element designated as the key closed or mark condition must be isolated from the distributor which introduces the start and stop impulses and also samples the other code elements. The second requirement is that a memory device must be provided which will, during the open contact period of tape advance, maintain the key open or key closed condition set up by the preceding set of perforations.

The polar relay is just such a device. Due to the magnetic latching action inherent in this type relay, it will remain in the position in which it is switched until a signal of opposite polarity is applied to the winding. Further impulses of the same polarity will not change the state of the relay. The same effect may be obtained by selecting a relay with two identical windings and reversing one of the windings. Use of a two winding relay introduces the requirement for the assignment of a second code element to represent the key open condition. This, however, poses no problem since a large number of pairs of Teletype code characters are so constituted that a specific impulse is present in one character but not the other and that for a second impulse the condition is reversed. Fig. 1 shows a circuit that will form CW characters from a series of higher speed pulses.

It is simple to connect the circuit of Fig. 1 to your present tape equipment. Merely run wires from the polar relay to the sensing pins for holes one and two on the tape or to the first two segments on the distributor, which are the same connections. You will want to have a switch in the circuit to return the tape equipment to normal Teletype operation. One contact of this can break one of the sensing connections, one can remove the dc from the relay, and the third can be used to switch the transmitter from CW to the TT connection.

Extra toggle switch mounting holes are provided in most Model 14 bases and one of these may be used to mount the switch. A satisfactory location for the polar relay poses a more difficult problems if the Western Electric 255A is used. The relay socket may be mounted on an outboard bracket or box which may be attached to the TD base or installed in another location. Details will be dependent on station layout and personal preference. Sigma Instruments manufactures a miniature polar relay which is housed in a round, octal based can. This relay, Sigma type 72AOZ-160TS-TCP, is a suitable replacement for the Western Electric unit and is small enough to mount under the TD base.

Tape preparation is simplicity itself. Select two adjacent keys on the second row of the keyboard, chosen so that the one on the left



contains the first impulse but not the second and the key on the right contains the second impulse but not the first. "F" and "G" were chosen by the writer as being most convenient. Depress the "F" key once for a dot and three times for a dash, using the forefinger of the right hand. Using the middle finger of the right hand, depress the "G" key once for the space between dots and dashes, three times for the space between characters and five times for the space between words. Figure 2A shows the word "TEST" perforated in the standard Teletype code on a Model 19 machine. Fig. 2B shows the same word punched for CW transmission.

Signalling rate in the CW mode is limited by the predetermined Teletype equipment operating speed. Assuming five letter groups and using the formulations of W4CF in the recent series of Hallicrafters advertisements on keyers,[1] there are some 52 code elements in a standard five letter group. This includes the character elements and the spaces between character elements, characters and groups. Since each set of perforations (or Teletype "operation") is equal to a code element, this figures as $\frac{368}{52}$ or slightly over seven words per minute on a 60 WPM tape head. A 100 WPM tape head would transmit at slightly over 11.5 words per minute.

Application of this method of transmission, in the stage of development described herein, is limited by the maximum code speed available. Obvious uses of this system are the automatic CW transmission of amateur call identification which is required by the FCC when using RTT, code practice and commercial and military applications where equipment failure or adverse conditions preclude the use of the normal mode of communication.

The most obvious improvement in this system would be to increase the speed of the tape head. This would, of course, prevent the use of the TD for normal Teletype transmission. The motor shaft is geared to a main shaft which revolves once for each character transmitted. Attached to the main shaft is the

(Continued on page 71)

[1] A more comprehensive reference was not available to the writer at the time this article was prepared.

A New All-Band Antenna

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An all-band antenna which gives perfect performance on every amateur band from 160 down to 10 is the dream of almost every ham. Many such devices have been described in the past, but all have represented compromises of one form or another. Some required additional tuners, a few utilized tricky traps, and several flatly failed to live up to their designers' claims.

Here's a new version of the all-band antenna, which offers less compromise than many of its predecessors. It involves no trap circuits, and will work without an antenna tuner (provided your transmitter can tolerate a load which varies between 50 and 450 ohms, always resistive) although use of a tuning circuit will give improved results.

Old-timers will recognize the layout of the antenna (see Fig. 1) as a derivative of the delta match, widely used some years ago to match the then-popular 600-ohm feed line to beam antennas. However, there's a major difference.

This antenna, dubbed the "Exponential Array" by the designer, matches the transmission line to free space.

The general theory employed in its design is a logical outgrowth of that used to develop the Discone antenna, once highly popular and still widely used in commercial circuits. In some respects, also, it is similar to the log-periodic antenna. And before the slide-rule boys rise in arms, we will admit that other theories insist that the thing can't possibly work. A bumblebee can't fly, either, by the laws of aeronautical engineering.

At this point, it should be emphasized that the dimensions shown in Table 1 have been measured and tested. While other dimensions should give equal results, nothing can be guaranteed if either leg length or feed-line length is varied. Don't let this stop you, though. Try it and let us know what happens for you.

The easiest way of building an Exponential Array is to stake out a pattern in the back yard (or a handy city park if no back yard is available). Measure off a line some 25 to 30 feet long, then mark off other lines at right angles to it every foot in a sort of herringbone pattern. Measure out the proper lengths and stake them.

Now, take your No. 14 wire and stretch it from stake to stake in the shape shown in Fig. 1. Use plastic clothesline for the horizontal stretchers—they're necessary to hold the array in shape once its erected. When spacing gets down to less than a foot, the traditional wax-soaked dowels can be used.

Once built, the array must be raised into position. The original was hoisted to an altitude of some 24 feet and supported by more plastic clothesline at each end. The feed-line was brought off horizontally so that the entire antenna was horizontal to the ground—but equally good or maybe better results should be attainable with the fan pointing skyward.

In theory, the Exponential Array's operation is simplicity itself. As you know, two parallel conductors (the familiar open line or twinlead) won't radiate if current in each is balanced, since the field of one cancels the field of the other. At the same time, the line exhibits a definite characteristic or "surge" impedance which is, in part, a function of the spacing between the wires.

If the spacing is increased (gradually, so that there's no sudden impedance "bump" on the line) the impedance will also increase. The line still won't radiate, so long as the conductors are spaced closer than about one-tenth wavelength.

As the spacing increases past the one-tenth wave dimension, the fields no longer cancel and part of the energy in the line is radiated into space. Another way of expressing the same result is to say that the impedance of space (377 ohms) effectively short-circuits the much higher impedance of the line at this point, and the power flows into the lesser impedance.

From the point at which the line is "short-

ed" by space, on to the end of the array, the wire might as well not be there. Its only function is to support the active portion of the array.

As you can see, the only part of the action which is frequency-sensitive is the point at which the array stops being a line and becomes an antenna. Theoretically, there should be no resonance in such an array, and impedance should be a constant 300 ohms from far below design frequency all the way up to SHF regions.

In practice, it doesn't quite work out this way. Much of the operation is not fully understood, but apparently the array acts as a cross between a dipole and a delta match. Using the dimensions of Table 1 a number of low-Q resonances were found. At these points (located in semi-harmonic relation, see Table 2) the impedance was as high as 450 ohms resistive. In between, the array exhibited mild reactance.

However, at no point in the range from 1700 kc to 30 mc did the impedance vary so widely that the array refused to accept power. When fed by a pi-net output network, the antenna loaded a homebrew final to rated power at all frequencies tried within this range.

At lower frequencies, the antenna is omnidirectional. When the broadside dimension approximates a half wave, the familiar dipole pattern appears. As frequency increases, the pattern approaches that of a V-beam as would be expected.

Incidentally, though no tests were run at UHF, the antenna was connected to the TV receiver—and pulled in Channel 10 from San Diego, some 250 miles to the south.

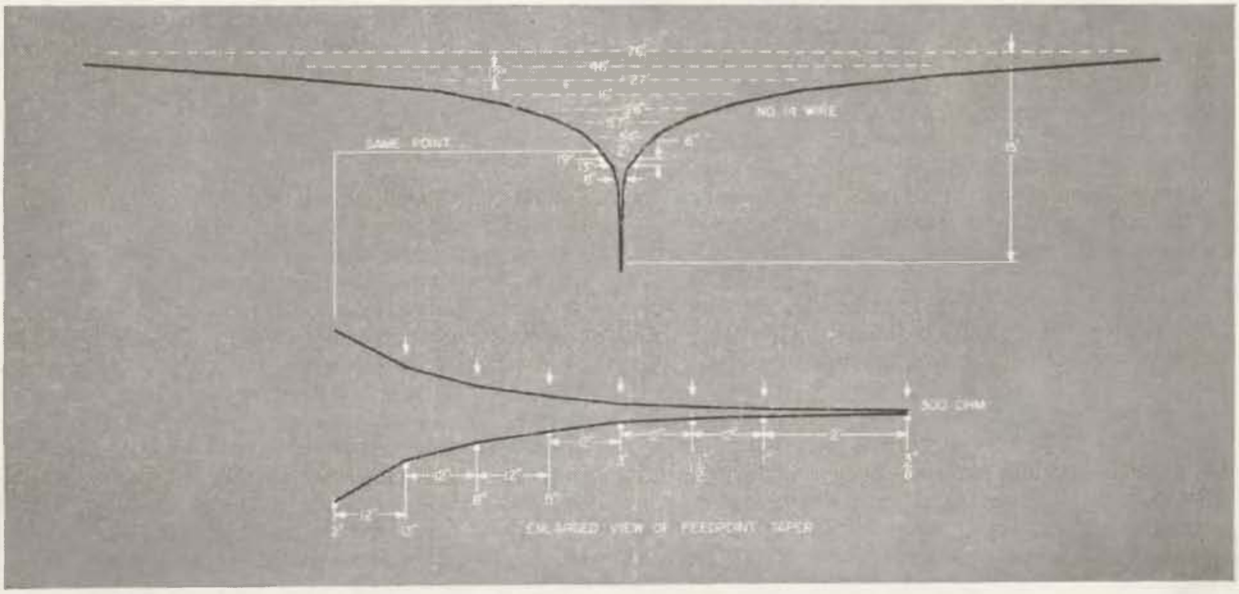
In summary, the Exponential Array offers a new approach to the all-band antenna situation, with promise of attaining the long-sought goal of perfect performance with no adjustments. More study by others is needed to develop full design information. The only claim made by the designer is that the experimental model worked, as evidenced by the measurements tabulated in Table 2. Try one at your QTH, and let us know how it works for you!

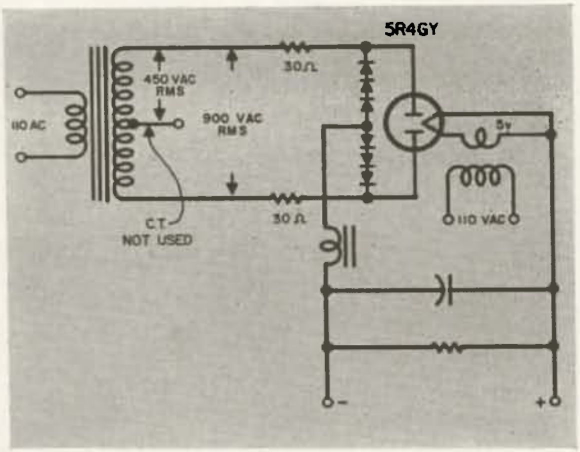
Distance from start (*in feet*)	Spacing
0	⅜ inch
1	9/16 inch
2	1 inch
3	1-11/16 inch
4	2-½ inches
5	4-⅞ inches
6	8-¼ inches
7	13-¾ inches
8	23-½ inches
9	3 feet 4 inches
10	5 feet 7 inches
11	9 feet 6 inches
12	15 feet 10 inches
13	26 feet 8 inches
14	45 feet 10 inches
15	75 feet 10 inches

TABLE 1. Dimensions of Exponential Array made of No. 14 Wire to Match 300-ohm Feed Line.

Frequency	Impedance
2450 kc	300 ohms
3850 kc	50 ohms
4900 kc	450 ohms
7500 kc	75 ohms
10 mc	50 ohms
15.25 mc	75 ohms
21.0 mc	125 ohms
27.5 mc	450 ohms
27.9 mc	200 ohms
28.1 mc	200 ohms
29 mc	450 ohms

TABLE 2. Variations of Impedance of Exponential Array of Fig. 1 with Variations in Frequency; measured with Heath Impedance Bridge and Grid-Dip Oscillator.





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A Different Approach

Doubling Your Power Supply Voltage

THERE are many times when it should be advantageous to double your power supply voltage, particularly when you have a project to build a linear amplifier for SSB, or change amplifier tubes to higher voltage and lower current for greater efficiency, yet would like to use the same power supply. The purpose of this article is not the construction of a particular piece of gear to be followed implicitly, but to suggest a method anyone may employ to fit their particular power supply problem.

The classic method in voltage doubling for transmitter supplies has been to employ the well known bridge rectifier circuit. Voltage doubling by the capacitor method has not been so popular when voltages really get up there due to regulation problems and the need for such large electrolytic filter condensers. Particularly when such good oil impregnated types are plentiful and relatively cheap and reliable. A major disadvantage of the bridge circuit is the four rectifying elements required and the three heater or filament sources. When you have an existing power supply, the addition of two more rectifier tubes and two more high voltage breakdown filament transformers, or a triple transformer, usually represents impossible space problems as well as a high cost factor.

To rip out the rectifier tubes in your supply and replace them with silicon rectifiers at first glance appears to be the solution, however this approach costs a lot of money today and it seems foolish to throw away usable rectifying capability. A hybrid power supply—half silicon and half rectifier tubes—appear to represent the happy medium as a solution of space and economy. Many existing supplies could use this method with a minimum of construction and cost.

The reader should not be lulled into forgetting the requirements for *any* method of altering a power supply to double your voltage output. Here are the key factors;

1. Be sure the rectifier filament winding insulation (and tube or tubes) will stand the new double peak voltage.
2. When the voltage output is doubled, the current will be halved. Your gain is through the use of amplifier tubes which are more efficient at the higher voltage. The amplifier input wattage may be no higher, but the output probably will be.
3. Your filter choke or chokes must stand the higher voltage breakdown required. A common "dodge" is to put the choke in the negative lead.
4. Your filter condensers must be replaced or be capable of withstanding the new higher voltage.
5. The bleeder resistor must also be of the proper value to meet the needs of the higher voltage.

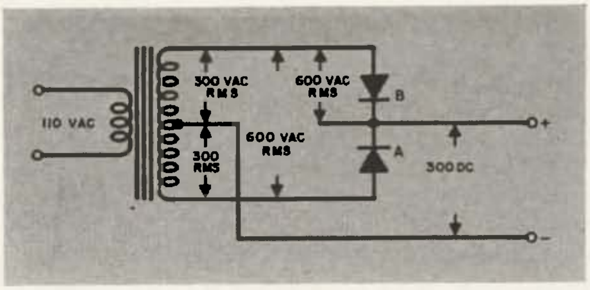
Fig. 1 illustrates a hybrid power supply. Note the surge resistors to limit current. These are usually from 5 to 30 ohms, depending upon filter capacity, and are placed in each leg of the power transformer secondary. A word about silicon rectifier ratings to be used would also be in order. A full wave circuit with 250 ma rectifiers would yield 500 ma, which is usually enough for most amateur applications. These sizes would be much cheaper, of course, than the 750 ma variety which, for example, would give you 1.5 amperes. However, nothing could be gained in a hybrid circuit with the larger rectifiers since this would be beyond the capability of commonly used rectifier tubes which

would be in the other half of your rectifier system.

There also appears to be much confusion as to rms and piv ratings to be used. I have often heard people express the belief that advertised values were incorrect. The error, I think, originates with the user. Fig. 2 is a simplified full wave schematic drawn to illustrate this point. When rectifier A is conducting, the *full* secondary voltage appears across rectifier B. This means that although you may have a simple 300 volt supply, *600* volts appears across each rectifier on alternate cycles, not 300! The moral is to be sure that the rms value of *each half* of your rectifier string will more than meet the *full* rms value of the transformer secondary, not one-half to the center tap.

The use of this hybrid method should become popular. Among the suggested conversions are to change 750 volt supplies to 1500 volts for 811A's or 2000 volt supplies, at which voltage 4-250A's and 4-400A's are notoriously inefficient, to 4000 volts. The space saved by this application will readily strike the prospective user and make possible a conversion that may have not otherwise been considered feasible.

. . . W4API



Impedance Matching in Surplus Equipment

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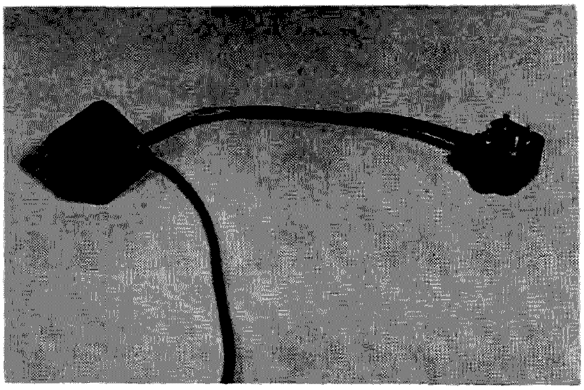
Radio Set	Transmitter	Receiver	Trans. In	Rec. Out
SCR-177-B	BC-191-C	BC-314-C	35 to 200	4,000
SCR-188-A	BC-191-C	BC-342-C	35 to 200	4,000
SCR-193-( )	BC-191-C	BC-312-C	35 to 200	4,000
SCR-399-A	BC-610-E	BC-312-( )	200	4,000
		BC-342-( )	200	4,000
SCR-499-A	BC-610-E	BC-312-( )	200	4,000
		BC-342-( )	200	4,000
SCR-506-A	BC-653	BC-652	200	8,000
SCR-508-( )	BC-604	BC-603	200	8,000
SCR-528-( )	BC-604	BC-603	200	8,000
SCR-509-A	BC-620	BC-620	200	250 or 4,000
SCR-510	BC-620	BC-620	200	250 or 4,000
SCR-543-( )	BC-699	BC-699	100	100
SCR-608-A	BC-684	BC-683	200	8,000
SCR-628-A	BC-684	BC-683	200	8,000
SCR-609-A	BC-659	BC-659	200	250 or 4,000
SCR-610-A	BC-659	BC-659	200	250 or 4,000
SCR-619-( )	BC-1335	BC-1335	200	250 or 4,000
SCR-694-C	BC-1306	BC-1306	160	250 or 4,000
SCR-808	BC-923	BC-923	200	8,000
SCR-828	BC-924	BC-924	200	8,000
AN/TRC-1-( )	T-14-( )/TRC-1	R-19-( )/TRC-1	500	500
AN/TRC-8	T-30/TRC-8	R-48/TRC-8	500	500
AN/PRC-8-10	....	....	150	600
AN/GRC-3-8	....	....	150	600
AN/GRC-9	RT-77/GRC-9	RT-77/GRC-9	160	250 or 4,000

THE INPUT and output impedance of military equipment is often unknown to the person considering amateur application of these items. Impedance matching is important and the use of matched audio accessories will do much toward correcting the fairly common and often unjustified complaint of insufficient audio gain.

The chart lists a number of surplus radio equipments and their audio input output impedances.

Impedance variations in transmitter input circuitry are not too great and in most instances match either a carbon microphone or a 500-600 ohm line. On the other hand, receiver output impedances vary widely and more or less unpredictably. Since it is usually desirable to effect a minimum number of internal equipment changes, consideration should be given to the use of external line matching transformers. Small commercial units are available to meet a wide range of impedance matching requirements and these transformers will often mount directly on the loudspeaker frame.

Careful attention to impedance matching requirements will result in improved performance of surplus conversions and use of external, speaker mounted line matching transformers will minimize the work in such projects. The results more than justify the expense.



Patch Patch

Allie C. Peed, Jr. K2DHA
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Rochester 20, N. Y.

ALL of the articles and instructions on phone patches end up by directing you to connect the line terminals of the patch to the red and green leads in your telephone's junction block. This leaves you more-or-less on your own from there on. As you can readily imagine, most telephone companies take a very dim view of anyone not in their employ connecting or disconnecting anything in their installations.

So, in spite of this, you're determined to have phone patch facilities (after all, other people have them) and you are willing to bear the possible wrath of the telephone company. If you take the step and are permanently connected, then in case of trouble on your line, the serviceman is likely to discover your connection, cut it off, report it to the company and blame you for any trouble on the line. Thus can begin a first-class rhubarb with you in the role of underdog.

Wouldn't it be better to have a patch installation which could be connected to the line by a plug-in connector and which could be plugged in when you want to run a patch and taken out when not needed—all of this to be accomplished without making any unauthorized changes in the telephone installation itself?

Fortunately, this is fairly easy to accomplish. The key to the whole thing is to have the telephone company install extension jacks in your house. For a small installation charge they will fit jacks at any and all locations where you might wish to plug in the telephone in your house. This doesn't add to your monthly billing. There is only the one-time-only installation charge. However, you must have at least two jacks installed.

Once the jacks are installed, you can unplug your telephone and plug it in at any jack in the house. Thus, when you want to run a patch, you can simply go and get the telephone and plug it in at the operating position.

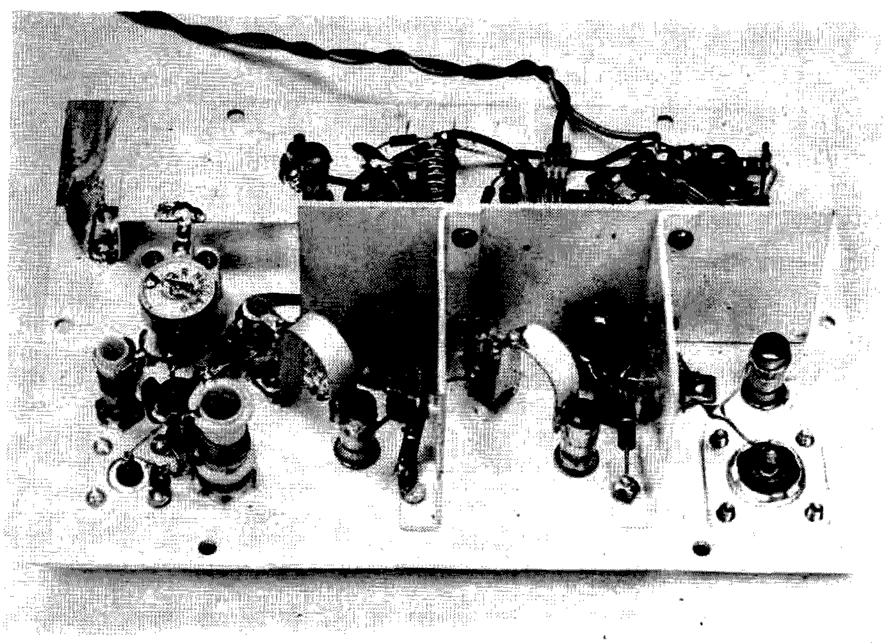
Make up a patch cord with your phone patch connection in the cord. Plug this cord into the jack and plug your telephone into the other end of this cord. When you are finished, put your patch patch cord back in a drawer, return your telephone to its regular resting place and there is no sign of your installation.

Unfortunately, the telephone company uses a rather odd type of four-pronged jack in its extension installations and these have until recently been hard to come by unless you had a friend at the telephone company. Recently, Olson Radio in Toledo, Ohio has started to market these plugs and jacks and a patch patch cord is practical for all now.

All that you need are one male and one female telephone extension jack connectors, a few feet of three wire cable and a few minutes of your time. The screw terminals in both the jack and the plug are marked with the color of the leads. Be sure to connect a wire between the terminals marked similarly, i.e., red to red, green to green, and brown to brown. Make this wire as long or as short as you need for your convenience in placing the telephone and phone patch unit at your operating position. The jack is made for surface mounting with two screws and can be mounted permanently on the desk by the rig if you choose.

Then, in either the plug or jack of your patch patch cord, connect the two line leads from your phone patch unit to the terminals marked red and green respectively. This can be a permanent type connection since the whole patch patch cord can remain at the operating position connected to the phone patch unit.

It's simple to use. Just plug the male end of the patch patch cord into the extension jack installed for you by the telephone company. Then, plug your telephone instrument into the female jack on the other end of the patch patch cord and run your patch traffic. When you are finished, merely unplug and store your patch patch cord and return the telephone to its usual position. Neat, eh?



A 432-436mc Transistor Converter

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Lansdale Division
Lansdale, Penna.

THIS article presents a fully transistorized converter operating in the 432 to 436 mc frequency band. It employs a crystal controlled local oscillator to improve frequency stability. A communications receiver capable of tuning the 28 to 32 mc range is used for the *if* system. It features an overall power gain of 31 db with a noise figure of 7.1 db. The 3 db bandwith was measured to be five megacycles.

The UHF spectrum presents a new challenge in the use of transistors. There has been very little in the way of published material on the usage of the transistors at these frequencies.

This converter was constructed with the idea of determining how effective transistors would be in functions previously accomplished by the use of vacuum tubes. The Philco small area MADT* transistor was selected because of its superior performance in the VHF spectrum.

The result was a 432 mc converter whose operation surpasses that of most tube types. Compactness and low power requirements make the transistors even more desirable.

RF Section

The two RF stages are operating as common-base amplifiers and the mixer as a common-emitter stage. A series capacitor, C2, couples the signal from the antenna to the emitter of the first RF amplifier stage. A variable capacitor, C1, is inserted between the input and ground. In operating an amplifier common-base, there exists some inphase feedback from the output back to the input circuit through the transistor. C1 is adjusted to minimize any tendency towards instability resulting from this feedback.

The output circuit is tuned by capacitor C3 and coil L1. A coupling capacitor C4 feeds the output to the emitter of the second rf stage. The output of this stage is tuned by capacitor C5 and coil L2. A coupling capacitor, C6, feeds the signal to the base of the mixer. A 30 mc trap is inserted between the base and ground of this stage. This trap short circuits the input admittance of the mixer at 30 mc providing higher conversion power gain. The output is coupled to the load through a

*Trademark—Reg. U.S. Pat. Off.

30 mc transformer consisting of coils L5 and L6.

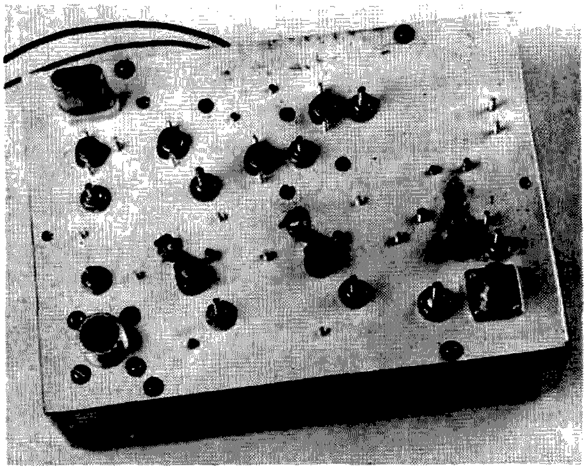
The local oscillator signal is injected into the emitter through capacitor C7. Coil L4 provides a high impedance at the local oscillator frequency and forms part of the emitter bypass network for the *if* signal.

Harmonic Generator

The first three stages are operating as common-emitter stages. The last stage is used as a grounded base doubler.

A crystal controlled oscillator is used for frequency generation. Capacitor C8 and coil L7 tune the output to 50.5 mc. A 6.8 mmfd capacitor matches the output to the base of the first frequency doubler. The output of this stage is tuned to 101 mc. An 8.2 mmfd capacitor matches the output to the base of the second frequency doubler. The output of this stage is tuned to 202 mc by capacitor C10 and coil L9. The output is fed to the emitter of the third frequency doubler by a tap on L9 and a 100 mmfd blocking capacitor. The output of the last stage is tuned to 404 mc by condenser C11 and coil L10. Capacitor C7 couples the power to the emitter of the mixer. C7 is peaked for maximum drive into the mixer.

The resistors located in the emitter circuits of the transistors provide the necessary dc stabilization. The others form bias networks to fix the operating point.



Construction

The photographs and coil data should assist in the construction of the converter. A 7 x 5 inch brass stock 1/16 inch thick serves as a mounting plate for the components. An aluminum chassis 7 x 5 x 2 inches serve as a shielded enclosure. Although silver plating the brass is recommended, it is not necessary. Good ground connections are necessary for proper operation.

Tuning Procedure

It is first desirable to align the harmonic generator stages to the proper frequencies. A wave meter/grid dip oscillator is very useful. In grid dipping the tank circuits, it is recommended that the transistors are removed from their sockets. Capacitor C7 is set to a mid value and then can be peaked up later.

Next, tune the output coil of the mixer to 30 mc. The 30 mc trap in series with the mixer base and ground should be disconnected during this tuning procedure. After the 30 mc output coil is aligned, the trap is resoldered back into the circuit. The trap is set with a grid dip oscillator by removing the mixer transistor and inserting a short between the emitter and base terminal. The slug of L3 is now adjusted for a dip at 30 mc. Remove the short and replace the mixer transistor.

A signal generator is very helpful in aligning the RF stages. With C4 set at maximum and C6 to about mid capacity, adjust C3 and C5 for maximum gain. The setting of C1 is not critical and can be left out if the first rf amplifier shows no sign of breaking into oscillation. If a noise generator is available, C1 can be adjusted in the following manner. Starting from minimum capacity, vary it until the noise figure begins to increase, then back off about one turn. At the point where the noise figure starts to increase, the power gain is decreasing rapidly due to a decrease in the regeneration of the first stage. As the gain of the first stage drops below a certain value, the noise contributed by the second amplifier stage is on the increase, hence the overall noise figure becomes higher.

Chart I indicates the current drain of the converter.

Chart I

Stage Current Drain (ma)

1st RF	2nd RF	Mixer	Xtal Osc*	Doublers 1st*	2nd*	3rd*	Total drain	Current (Bleeder I included)
1.5 ma	2.0	2.0	2.0	2.5	3.0	3.0		20.5

*Note—Includes dc bias current.

Driving power also influences the current flow to some extent.

The high gain characteristics of the front end results from regenerative amplification due to the common-base operation. Equivalent gain figures can be had by using slightly over neutralized common-emitter stages. Neutralization above 400 mc becomes difficult. Despite this, the overall 3 db bandwidth is over 5 mc with good stability. One disadvantage of a common-base amplifier is that power gain and bandwidth varies considerably with transistors. Tabulated below are some gain and bandwidths that were observed using a number of transistors.

Overall Power Gain	Overall 3 db BW	NF using L1262A diode	NF using 5722 diode
22—31 db	8—5 mc	6.5 to 8.2 db	5.2 to 6.8 db

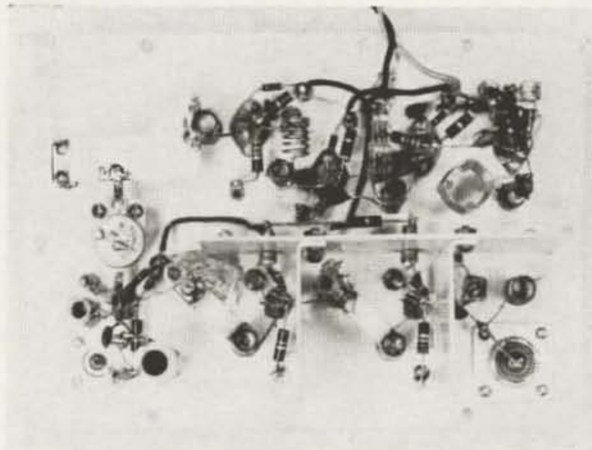
The reason that the noise figure readings are given from two types of noise generators is that the 5722 noise diode is still used by some in determining noise figure. The lead inductances of the 5722 at this frequency tend to produce a better noise figure than the stage really exhibits. A commercial unit produced by the Hewlett Packard Company employs a L1262A noise diode as its generator. The readings using this type of diode produce a more accurate reading. The Hewlett Packard noise diode is guaranteed accurate to 600 mc.

Parts List

C1, C3, C5, C11—0.5-5.0 mmfd Piston Capacitor JFD VC5
C4, C6—1.0-9.0 mmfd Piston Capacitor JFD VC9
C7—7-45 Ceramic Trimmer
C8, C9—1-18 mmfd Piston Capacitor JFD VC4-G
C10—0.5-8 mmfd Piston Capacitor JFD VC1-G
Xtal—Overtone Xtal Petersen type Z-9A

Coil Data

L1, L2—Made up from 2½" x ¼" brass stock 1/32" thick, silver plated.
L3—14 Turns #28 Nyclad copper wire close wound on ¼" form (Cambion type LS-6 with powdered iron core #20063-0).



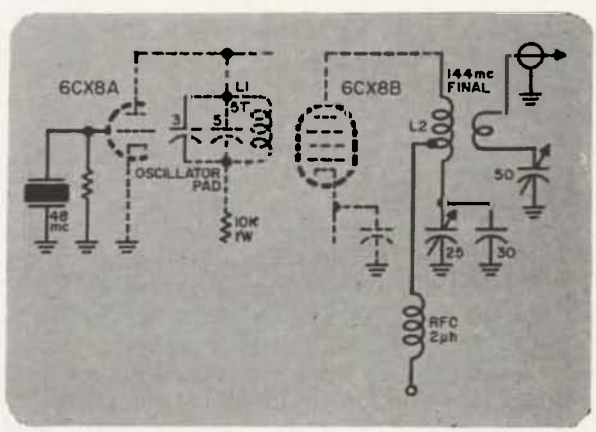
L4—1 Turn #22 tinned copper 3/16" inside diameter.
L5—18 Turns #28 Nyclad copper wire closewound on ⅜" form (Cambion type PLS5-2C4L with powdered iron core #20063-N).
L6—3 Turns #28 Nyclad copper wire closewound over ground end of primary winding L5.
L7—10 Turns #20 tinned copper ½" inside diameter, ⅝" long (B & W Miniductor #3003, Airdux #416T).
L8—3 Turns #20 tinned copper wire (B & W #3003).
L9—5 Turns #18 tinned copper ¼" inside diameter, ½" length, tap 1¼ Turn from ground end.

Converting the Tube Tube Tube, Watt Watt Watt Watt Watt, Meter Meter Meter Meter Meter Meter to the Tube Tube Tube, Watt Watt, Meter Meter

HERE is a quick way to get on 2 with the least amount of effort and dough ray me. It is amazingly simple and quick. First of all look up the first "73" issue (Oct. '60) and on page 32 you will find a little 6 meter rig by the author. Only 3 modifications need be made to convert this rig to 2 meters. This should be an excellent project for the Novice who would like to take a crack at this VHF band. If the instructions are followed carefully there should be no problems such as getting on the right frequency.

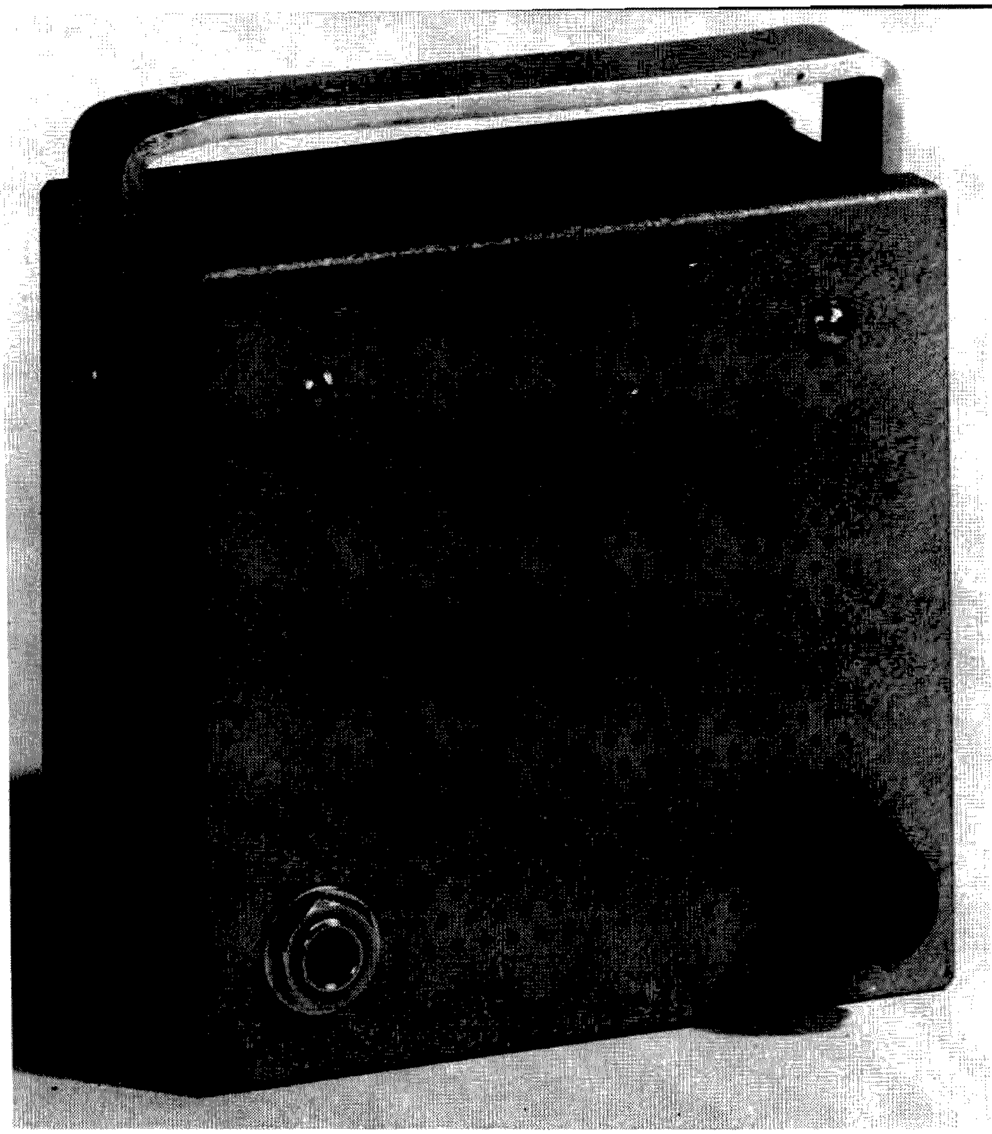
The first thing needed is a 48 mc third overtone rock. For the Novice approximately 48.5 mc is needed which will have a final frequency of 145.5 mc well in the Novice band.

The coil modifications to be made are the following; Add a 3 mmfd capacitor to L1 parallel to the 5 mmfd to reduce the oscillator resonant frequency. Take a piece of #14 wire and wind 4 turns ¾ inches in diameter. Remove the 6 meter final coil L2 and install the 4 turn coil in series with the plate of the 6CX8(B) and the 25 mmfd variable capacitor. Pad the 25 mmfd capacitor with a 30 mmfd. Make a 1½ turn antenna coupler coil from a piece of solid hookup wire ¾ inches in diameter. Place the antenna coupler coil L3 between turn 1 and 2 from the plate end of the final coil. Solder the 2 μh RFC choke 1 turn from the capacitor end.



Now the power can be turned on and tune'er up. The tuning procedures are the same as with the 6 meter rig.

Since the frequency is tripled in the final it is not the most efficient 2 meter rig, but you can have a lot of fun getting on the air. It's fine for local rag chewing. Better results can be expected if a shield is used between the oscillator and final. . . . K8NIC/5



Transistorized Loudspeaker

(Actual Size)

Squawk Box

Jim Kyle, K5JKX/6

A SURPRISING amount of excellent equipment, much of it virtually ready to use, is still available in surplus throughout the country. For VHF and/or mobile use, especially, surplus stocks still prove a gold mine.

And since conversion of the standard auto voltage from six to 12 volts, the same as the long-established military standard, many items require no conversion before installation. No conversion, that is, except to provide for loudspeaker operation. . . .

Almost every military use for the equipment required headphone output; virtually none of the mobile-adaptable gear now to be had was originally equipped to drive a speaker. But phones are inconvenient, to say the least, in the amateur mobile service.

The simple way out of this problem is not to convert the equipment at all, but to add an outboard power amplifier. Since the transistor works excellently at 12 volts, its use is a natural. But this is *not* just another article on how to build a transistor audio power amplifier—it introduces a completely different type of audio output circuit, which can only operate with transistors. In addition to the four transistors, though, you need only two resistors, one transformer (for input, not output!), and the speaker itself. A power amplifier can hardly be simpler than that.

This amplifier operates on the bridge principle, thereby eliminating any dc from the loudspeaker while still doing away with the output transformer. A simplified schematic is shown in Fig. 1, with the transistors represented by variable resistors. Assume that the setting of each resistor is accomplished automatically by the input signal as shown by dotted lines: a positive-going input increases the resistance while a negative-going input reduces resistance.

If, at the beginning, all resistors are set to the same value, the bridge will be perfectly balanced and no current will flow through the

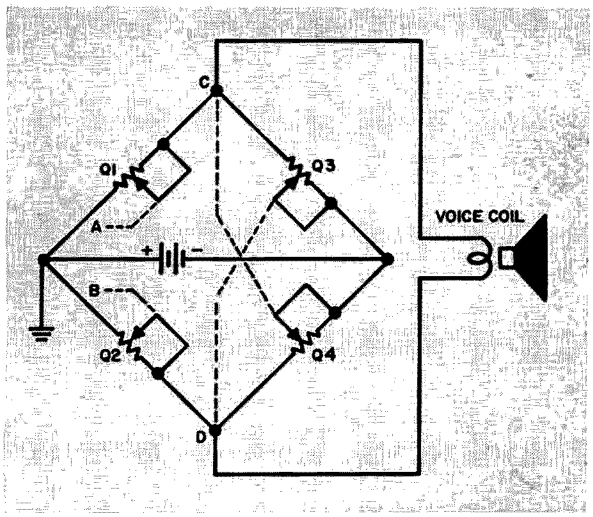


FIG. 1. Basic bridge amplifier, simplified schematic diagram. See text for details of operation.

voice coil.

However, if the voltage at input A goes negative while that at point B goes positive (both voltages referred to ground potential), then Q1 will decrease in resistance while Q2's resistance increases. Forget Q3 and Q4 for a moment—even without them the bridge is no longer balanced. This makes the voltage at point C less negative (or more positive) than it was at balance, while the voltage at point D goes more negative than before.

Now look at Q3 and Q4. They derive their resistance-control inputs from points D and C, respectively. As point C goes more positive, the resistance of Q4 increases. At the same time, with point D going negative, Q3's resistance drops.

This action pushes the bridge even farther out of balance, with resistance of both Q1 and Q3 lowered and Q2 and Q4 increased. Current flows from point D to point C, through the voice coil.

The action just described takes place on each cycle of audio frequency power, and the same action with reversed polarity occurs on the other half-cycles. As a result, the current through the voice coil is that of the af waveform applied to the input terminals.

During this action, each transistor is acting more like the automatically-variable resistor we have assumed for explanation than it is acting like an amplifier. Its resistance will vary from approximately half an ohm as minimum to a maximum of several thousand ohms.

This means that current flow through the voice coil is limited, not by the transistors, but by the impedance of the voice coil itself. To be more exact, this circuit is capable of producing approximately 18 watts in an 8-ohm speaker, or 36 watts in a 4-ohm unit, provided only that the transistors are capable of handling that variety of power.

The unit shown in schematic form in Fig. 2 isn't that powerful. It was built for the express purpose of bringing output from a BC-1306 up to speaker level for mobile use. Its power is approximately half a watt, using type 2N107 transistors.

To protect the transistors from overload, the input was deliberately mismatched. Since the case containing the speaker and amplifier was also to serve as the control unit for the BC-1306, the 500-ohm gain control, microphone jack, and switch (visible in the photos) were added. A six-wire cable connects the squawbox to the trunk-mounted 1306.

Construction of the unit is simplicity itself. The transformer, transistors, and resistors are first mounted on the cardboard chassis and all interconnections are made. Power, input, and output leads are brought out with stranded hookup wire, and the chassis card is then attached to the back of the speaker with two 8-32 screws. Input leads are connected to the gain control, output leads to the speaker voice coil, and the proper power lead (depending on polarity of your car's ignition system) is run to the power switch. The other power lead is grounded.

To use the unit in a non-mobile application, just add a small battery (anything up to 30 volts is fine; the transistors are effectively in series, so maximum-voltage ratings won't be exceeded) and you're in business.

To adapt this gadget to higher-powered use, simply match the input impedances of the first two transistors (Q1 and Q2) for maximum power transfer, and supply enough driving signal to push them to saturation. Presto, power! Values of the two resistors might be trimmed in either direction for maximum power output, also—it didn't prove necessary here. **73**

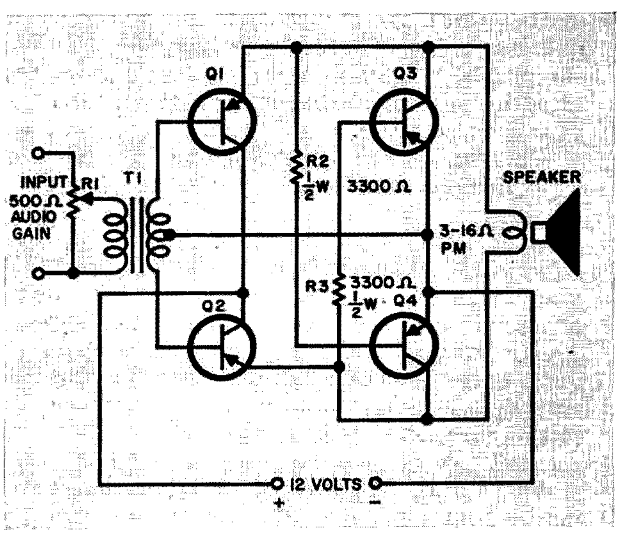


FIG. 2. Schematic diagram. Q1-Q2-Q3-Q4 should be PNP transistors of the same type . . . such as 2N107 or CK722. T1-Input or interstage transistor transformer. A Stancor TA-32 with primary and secondary reversed and only half of the original secondary connected was used in the prototype for deliberate mismatch to protect the transistors from overload.

a technical discussion of receiver front ends

Up Front

Staff

"You can't work 'em if you can't hear 'em," is one of the oldest maxims in ham radio. Since virtually no one is certain that his receiver possesses ultimate sensitivity, everyone wants to improve that department of his shack's equipment.

Fortunately, sensitivity of most receivers can be improved—and it doesn't cost a fortune, either. Tube designs developed during the past 10 years far exceed the wildest dreams of pre-1950 receiver designers, and as a result, improved receiver sensitivity is simple for older sets. Although newer rigs make use of the new tubes already, there are gimmicks for them too.

In modifying an existing receiver for greater sensitivity, you have a choice of three courses: substituting of hotter tubes, changing circuitry, or using plug-in adapters. The choice is up to you, but to make it intelligently you need full information about all results to be expected, both good and bad. That's the purpose of this article. In addition to a survey of the design factors you will encounter, you'll find a selection of circuits. At least one of them should, with only minor modifications as dictated by your requirements, prove suitable for your own receiver.

While there are several points in a receiver at which changes can provide greater gain, the "front end" (rf stages and mixer considered as a unit) controls the set's sensitivity. Any gain which follows the front end will amplify only receiver noise, and will be of no practical use in hearing those weak signals. The gain will make strong signals stronger, to be sure, but the weak ones can be captured only by improving matters up front. Since this is the case, let's look at the first rf stage for a start.

An rf stage, to the set designer, has three major functions. Providing sensitivity for the set is only one of the three. The other two are to isolate the local oscillator from the antenna and thus prevent radiation, and to eliminate or minimize image response. Frequently, commercial designs are based on isolation or selectivity rather than on sensitivity—and so can stand improvement in the matters of noise and gain.

Much has been written on the subject of noise in rf amplifiers, and many persons are now convinced that all rf amplifiers should use only triode tubes to achieve low-noise results. Don't you believe it. . . .

While triodes, with their fewer elements, do show lower noise than their pentode counterparts, the difference becomes significant only at VHF frequencies and above. Even at 50 mc, a well-designed pentode amplifier will reach below the level of antenna noise—and when you've gone that far, you're at the end of the line. No amount of improvement of your set can reduce antenna noise.

At this point, before reading much more, you can perform a simple test to determine whether your receiver is already at the limit of usable sensitivity. If it is, concentrate on the antenna—work on the receiver front end under these conditions is only wasted effort.

The test is this: Turn on the receiver and adjust all gain controls to the wide-open position. After the rig warms up, disconnect the antenna. Substitute a ½-watt carbon resistor with the same resistance as the antenna, at the receiver ANT terminals (use either 51 ohms, 75 ohms, or 330 ohms). Reduce rf gain until noise hiss from the speaker is barely audible. Disconnect the resistor and reconnect the antenna. If noise output increases, you're already able to receive antenna noise. If no increase results, your receiver can stand improvement. The test, incidentally, should be performed at your receiver's highest operating frequency since noise level from the antenna decreases with frequency.

If you're still with us, the next step is to decide whether you want to (a) use newer tubes (b) change the rf-stage circuits, or (c) use a plug-in gadget.

Use of a later-model tube which can be simply plugged into the set is always tempting—but this way lies disaster. Tubes vary in many factors besides that of gain; input and output capacity may be so far off that the set can't be aligned, the grid cutoff characteristic may prevent proper AVC action, the hotter tube may cross-modulate all signals. . . . The list is long and the pitfalls many. However, with proper care, excellent results are possible.

Circuit changes, similarly, can create many problems. Lead dress is critical above 25 mc. Circuits which are excellent at 30 mc give up and die at 3.5. The set may fail to track after modification. In other words, this too takes some prior planning.

Plug-in gadgets combine the advantages—and thus share the disadvantages—of both the other types of changes. In addition, they have peculiarities all their own. The worst is their tendency to oscillate, caused by necessarily long grounded leads. This can be cured by an external grounding strap—but it's an awkward device at best.

One aid to making your choice is to list everything you hope to achieve. If sensitivity (greater gain and/or less set noise) is the only goal, a simple tube switch with minor circuit changes will usually achieve it. On the other hand, if you need greatly improved sensitivity, better image rejection, and increased oscillator isolation your only hope is to change the complete circuit. In-between results may be obtained in any of the three possible ways.

Naturally, if you're switching from pentodes to triodes or vice versa you'll have to make circuit changes. Therefore, one of the early decisions leading to the big choice is that of which tube type to use.

To start with, all discussion of triodes vs. pentodes is based on the idea that only the best of each type are being compared. It's only logical that a fair triode will outperform a poor pentode, and than an excellent pentode will run rings around either.

But when you compare the best of each breed, you'll find that triodes are characterized by extremely low noise, moderate gain, and severe instability when used in conventional circuitry. Pentodes, on the other hand, have excellent gain and good stability, but show higher noise than their three-element cousins. For operation at 50 mc and below, the nod goes to pentodes when considering only the best of each type.

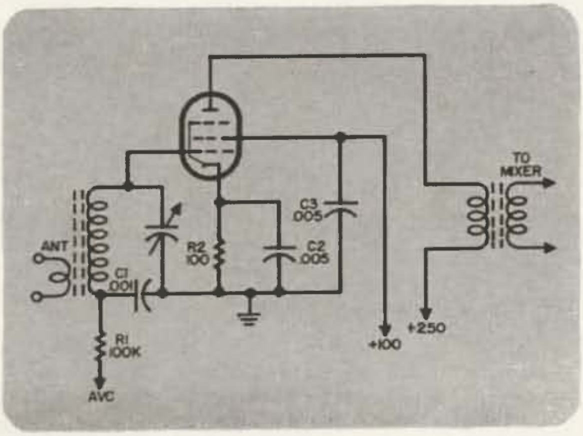


Fig. 1. Typical circuit of receiver first-rf stage. Tube may be almost any remote-cutoff pentode. Screen returns to low-voltage line established from receiver power supply.

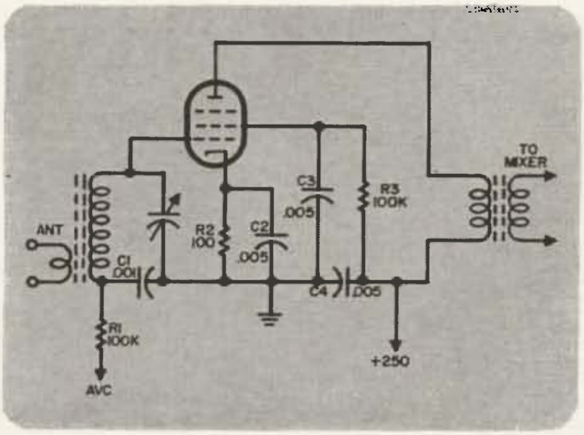


Fig. 2. Adding a high-valued resistor from screen to plate supply in the circuit of Fig. 1 results in the tube's gaining semi-remote-cutoff characteristics. No other changes are necessary.

In practice, quality is usually expensive. As a result, triodes hold a slight edge in the 20-50 mc frequency range, since the popular cascode circuit gives them both the pentode's advantages and retains their low-noise characteristic—all at a moderate price.

In addition, any rf stage can be converted to a cascode by means of a plug-in adapter (see the references) at low cost.

For use below 20 mc almost any recent-model pentode gives good results. Even the ancient 6SK7 series performs well at these frequencies, but it can be improved. In this range, tube substitution is the best policy.

To substitute tubes, start by obtaining a good tube handbook. The best are the RCA Tube Handbook HB-3, in five volumes and priced at $17.50, and the GE Electronic Tube Manual, also in five volumes and similarly priced. These books list all characteristics of all tubes produced by these firms, rather than the abbreviated listing of popular tubes found in the smaller manuals, and are highly recommended. However, information in the $1-range tube manuals is accurate and can be used.

With handbook in hand, first look up characteristics of the tube now used in your receiver. Write them down. Be sure to check input and output capacities, operating bias range, electrode voltages, and transconductance.

Then, start through the handbook looking for tubes which match yours in all characteristics except transconductance, which must be greater. The best areas to search first are the 6BA- through 6ES- type prefixes, since those are the newest types.

When you have several candidates, check to see that basing arrangements are compatible. It's easy to change socket connections, but not so easy to change the socket itself.

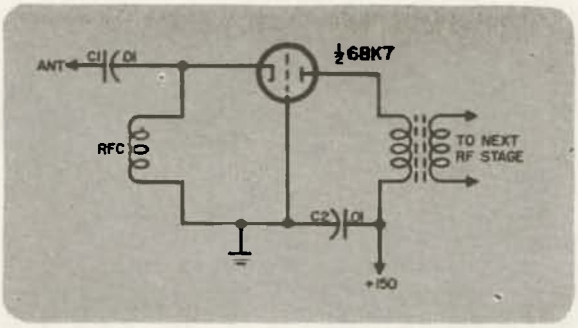


Fig. 3. The simplest triode amplifier circuit is the grounded-grid arrangement, shown here. Its major disadvantage is low gain, requiring at least two stages of rf amplification.

Finally, look at the characteristic curves for both the existing tube and your replacement candidates. If the general shape is the same, the candidates will probably perform satisfactorily.

When all this preliminary paperwork is complete, the only thing left to do is to try the tubes and see what happens. Plug in the replacement tube (making wiring changes if necessary) and try it. Check carefully for proper AVC action as well as improved sensitivity, and test for cross-modulation by tuning to weak signals near strong ones. If the strong signal rides in on the weak one, you have cross-modulation which must be corrected by changing to another type of tube.

One of the biggest compromises you must make when choosing front-end tubes is that between maximum gain and minimum cross-modulation. Remote-cutoff tubes are usually better when avoiding cross-modulation, but maximum gain is achieved only with sharp-cutoff tubes. Fortunately, it's usually possible to reach the antenna-noise level with good remote-cutoff tubes.

Tube substitutions usually take care of any problems below 20 mc. At higher frequencies the choice is between the use of plug-in adapters and changing the circuitry. Since plug-in adapters share many of the features of circuit changes, let's examine circuitry first.

The basic circuit used for the first rf amplifier in most receivers is shown in Fig. 1. Component values shown are only typical—exact values, naturally, will vary from set to set depending on the tube and the designer's whim. All bandswitching circuitry has been omitted for simplicity.

This circuit has no inherent noise properties, but the tubes most adaptable to use in it are not the most sensitive rf amplifiers available. As mentioned earlier, sensitivity and freedom from cross-modulation seldom go hand in hand. And in the circuit of Fig. 1, freedom from cross-modulation requires remote-cutoff tubes.

The simple change shown in Fig. 2 will make any sharp-cutoff tube act like a semi-remote-cutoff design, for reasons too complicated to go into in detail here. Component values in this diagram, also, are typical—with the exception of the screen resistor, R3, which is applicable to any tube.

With this change, you can safely use such tubes as the 6BC5, 6BC6, and 6DK6, all of which give higher gain than most remote-cutoff tubes.

If you decide to switch to triodes for their lower-noise properties, you can take your pick of a number of circuits. As mentioned before, there is little advantage in triodes below about 60 mc, but in a few cases they work better than pentodes.

One of the simplest triode circuits is the grounded-grid amplifier, shown in Fig. 3. Use of this circuit requires that two stages be employed, and overall gain will undoubtedly be lower than with the older pentode. Noise, however, will drop more than signal strength, which means that a hotter tube can be used in the *if* strip to bring back all the lost gain with lower front-end noise.

The two stages required by most triode circuits can be combined in the same space occupied by a single pentode. One way of doing this is by using the cathode-coupled amplifier, Fig. 4. Signal strength, again, will show a slight drop compared to the replaced pentode—but noise will be much lower.

The only triode amplifier circuit capable of competing at equal status with pentodes in the "stage gain" department is the cascode, shown in Fig. 5. Gain is equal to or greater than that of most pentode stages, while noise level is even lower than that produced by most other triode circuits. Since complete analyses of the circuit have recently been published

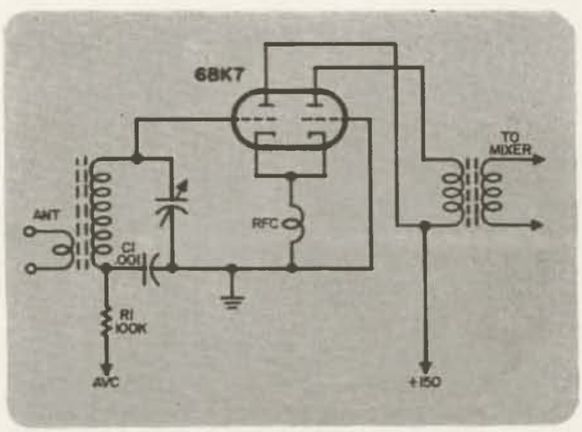


Fig. 4. This cathode-coupled amplifier can be substituted for standard pentodes in any receiver. The only part added to the receiver will be the rf choke in the cathode lead.

elsewhere (see bibliography), it won't be gone into in detail here.

Any of these circuits can be constructed on

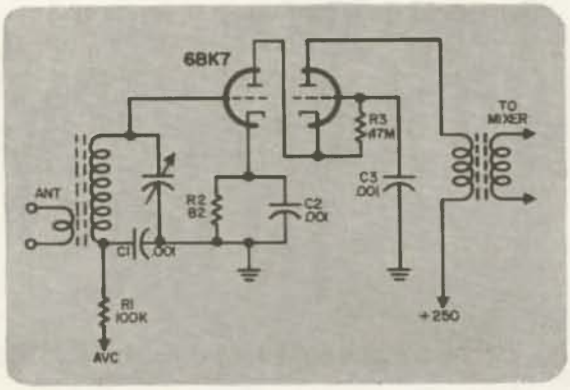


Fig. 5. This cascode circuit is the only triode rf amplifier which beats pentodes in their own field. It can be built in with addition of only four components.

a small plate of copper or tin-can stock using Vector turret sockets, and substituted for the old octal socket in the set. Naturally, the receiver must be realigned after any such change. •

These circuits (except the grounded-grid) are also adaptable to being constructed in the form of plug-in units which simply substitute for the existing rf tube. Complete units of this nature are the S-9er, the Improved S-9er, and the S-9er Mark II (see bibliography again). The pentode circuit change can also be incorporated into a plug-in adapter.

With noise in the first rf stage minimized, it's time to check elsewhere in your efforts to attain the ultimate in sensitivity. Frequently, the mixer stage of a receiver makes a substantial noise contribution and masks weak signals. This is especially true if the first rf stage is not doing its job properly, but by now that portion of your set should be at peak performance.

The difference between a quiet and a noisy mixer is largely a matter of tube choice. Mixer tubes designed especially for low-noise service include the 6BA7 and the 6SB7-Y (now almost obsolete.) The 6U8 is a good one also but usually requires circuit changes.

If you don't mind extensive surgery inside the set, substitution of a 6AC7 operated as a pentode mixer as shown in Fig. 6 will yield exceptionally low-noise mixing action. However, you may experience a bit of difficulty in realigning the set after this change due to the drastically different circuit and resulting change in circuit capacities.

Once the proper tube type is substituted, a few changes in circuit constant may increase mixing sensitivity. Lowest noise and greatest freedom from cross-modulation are obtained with a non-grid-leak-biased mixer. However, such mixers are also the most sensitive to variations in oscillator output and so are usually avoided by set designers.

Bias values for the mixer tube of your choice can be obtained from the tube-handbook charts. Either fixed grid bias obtained from the power supply or from a mercury cell, or cathode bias developed across a resistor of the proper size (as shown in Figures 6 and 7), can be used instead of the original grid-leak biasing. The grid resistor can then be reduced in value, or left unchanged.

With any biasing arrangement other than the grid-leak circuit, mixer performance is extremely dependent upon proper oscillator injection voltage. Oscillator output must be adjusted while listening to received signals, for best results. At the right point, you will notice low noise, good gain, and little distortion. Excessive oscillator output will result in reduced gain and increased noise, while too little output gives relatively noise-free results but little mixing gain.

A circuit for use of the 6U8 is shown in Fig. 7. Note that no coupling between oscillator and mixer is indicated. All necessary coupling is provided by the proximity of the tube sections within the envelope. This circuit, adapted from the *International Crystal Mfg. Co.* model

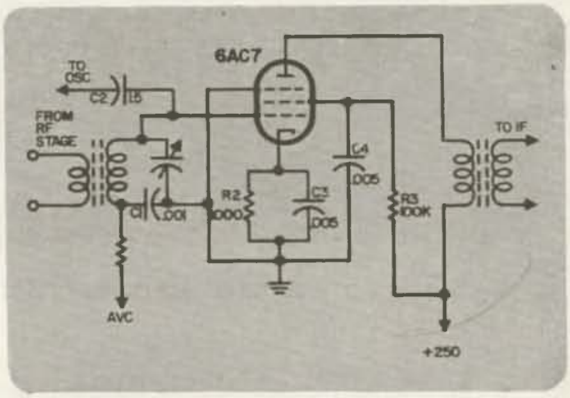


Fig. 6. The 6AC7 mixer circuit shown here gives lowest mixer-stage noise output of any frequency converters tested, according to research reports. Its major disadvantage is the extensive set surgery required for installation.

FCV-2 converter, provides exceptional results when preceded by one stage of rf amplification, even at 144 mc. •

With both the rf stage and the mixer cleaned up, there's little more to do in your search for sensitivity. It's a good idea, however, to check AVC action after all modifications have been made. Tube and circuit changes sometimes upset normal functioning of this important circuit, since action of the front end at low bias voltages may be vastly different from its action near tube cutoff.

To check AVC, tune across the broadcast band if your receiver has one. Lacking that, listen to the kilowatt down the block. Examine the signal carefully to see if you can detect distortion, splatter, or other objectionable features (the broadcast station is recommended

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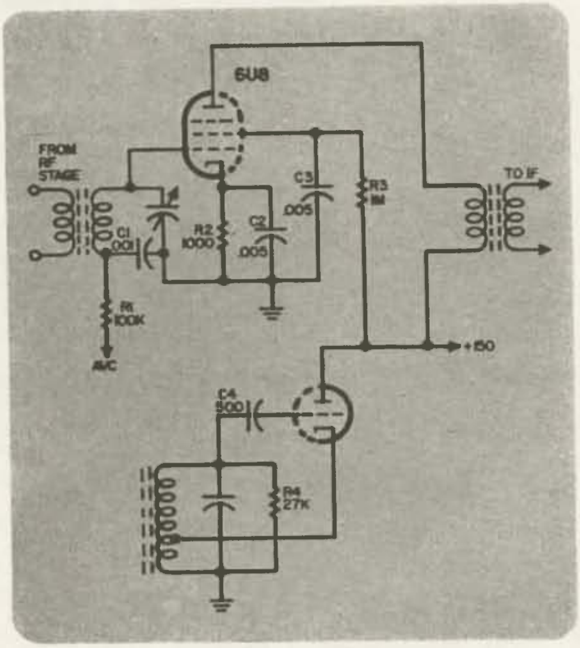
for this test, since the characteristics of its signals are more closely controlled.) If you spot trouble, repeat the test on a weak signal.

If trouble is apparent only on strong signals, the AVC circuit probably is at fault. Most usual cause of this difficulty is indiscriminate tube substitution without regard for cutoff characteristics; a tube which goes dead at 10 volts bias can't give good results when used on an AVC line developing 20 volts.

Double-check the cutoff curves and values for both the old and the new tubes. If there's much difference, rig voltage dividers using the AVC resistors (R1, Fig. 1) as the upper leg of the divider to cut AVC voltage down to size. This usually cures the problem.

After finishing this test and any necessary rework, go back and repeat the sensitivity test. You should, now, have no difficulty in reaching the antenna-noise level. Tune across 10, 15, or 20, and note the difference. Your receiver now has what it takes, where it counts —up front!

Fig. 7. Using half of a 6U8 tube for the oscillator and the other half as a mixer, this circuit is capable of outstanding performance at frequencies up to 148 mc. It requires only one stage of rf amplification ahead of it.



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*Available from Radio Bookshop.

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Ken Johnson, W6NKE

"THE ONLY good bug is a dead bug," says one of the TV commercials. A little listening on the CW bands may convince us that this rule should be applied to ham radio too. Not so. Despite all of the horrible examples we hear on the air it is true that any operator can master these slippery customers. If you get the bug to use a bug get the bugs out of the bug before you bug people.

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You can answer this question only after answering a couple of others. First, can you handle a straight key satisfactorily at twenty words per minute? Second, can you make solid copy at least the same speed or better? If the answer is yes to these two latter questions, it will be yes to the first one. You are now ready to take the sacred oath and vow of all good bug twiddlers. Repeat after me.

"I, Sam Lieberknocker,* do take this oath and vow that I forever more will keep this little monster under control at all times and never exceed the speed limit set by my own capabilities. This, I swear to on a stack of TVI complaints."

Now that this impressive ceremony is over and we have dried the tears of emotion from

*In case your name does not happen to be Sam Lieberknocker it is permissable to make a reasonably accurate substitution as long as you do not make any other modifications, however slight, of this ritual.

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our eyes, let's get to work. First, blow some of the heavier encrustations of dust off old code oscillator. Hook the bug to it and plug it into the wall socket. Whoops! There went the fuse! Now just replace it and the fried filter condenser.

Once you have the oscillator working it is time to adjust your bug. First, check the adjustment of the pivot bearings on the dot armature. These should be loose enough to allow the arm to move freely in a horizontal direction between the two stops but there should be very little vertical play. Next, move the weights out to the end of the dot armature and tighten them securely. Loosen the right hand dot armature stop adjustment. Operate the armature with your left hand and set the stop so that when the paddle of the bug is released, the armature damper stops all armature vibration at the instant it comes to rest against the stop. Screw down the locknut and take a drag on your cigarette. Relax, you should never have to make this adjustment again. Now set the left hand armature stop so that the tip of the armature travels in approximately a half inch arc.

With the dot armature pushed over against the left hand stop, screw the adjustable dot contact up until it touches the spring contact. Check to see that they align perfectly, then back the adjustment off again. Operate the dot armature and adjust the contacts until you can hear approximately ten good clean dots before the armature quits bouncing. Lock the adjustment and relax again. Set the dash contact spacing and spring tensions to your liking and we're ready to give the little rascal a trial twiddling.

The proper way to handle the paddles is up to you. Of course, there's no way out of using your thumb on the dot side. For the dash side, pick a finger that's handy and comfortable and relax your arm. The secret of good clean sending on your bug is to keep your arm and wrist relaxed and use a smooth combination of wrist and finger motion, plus rhythm. A good exercise is to sit and practice sending a series of V's.

Fire up your receiver and tune around on the commercial frequencies until you find a station running around twenty to twenty-five words per minute with tape sending. If you happen to have the type of receiver that tunes only the ham bands, don't be discouraged, there are plenty of commercials using these frequencies too.

Now that you've found one, listen to the dots. Cock your other ear toward your oscillator and punch the dots on your bug. Adjust the weights on the dot armature until they are the same speed as the tape. If they seem too heavy or light after this maneuver, a slight adjustment of the spacing between the dot contacts will remedy this. Of course, if you are lucky enough to have your own tape machine, you can forget about the above system and check your bug against its sending. We all know that a dash is supposed to be three times as long as a dot. Remember this and get your latest copy of "73" off the shelf and practice sending text from it. Try to make your fist as identical as you can to tape sending and don't worry about picking up speed. One of the common faults of some bug twiddlers is that they send their dots at sixty wpm and their dashes at twenty. Speed will come with practice.

You've no doubt noticed that between us we haven't even mentioned trying your bug out on the air. I know you're anxious to give it a whirl but please think of the guy who would have to try and unscramble your first efforts. Listen around for awhile and you'll find the type of character who has learned to send CQ and his call very neatly on his bug. Then listen to what happens when he comes back to a call. He sends *6*'s for d's and b's, i-n for f, etc., etc. The point is that you certainly have more respect for your reputation and that of your station than to get on the air before you can handle yours. It may be boring but keep at it with the oscillator and practice, but the practice you get in this manner will make the difference between the smile of appreciation when another ham tunes your signal or having him laugh as he tunes away from "that Lid!"

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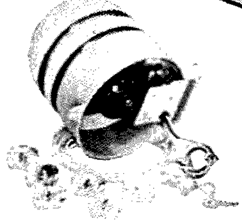

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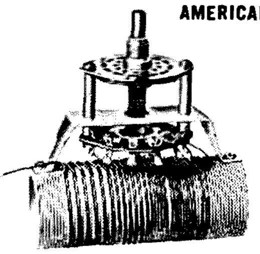

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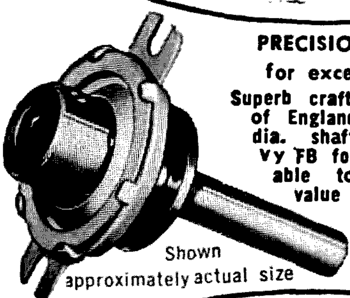

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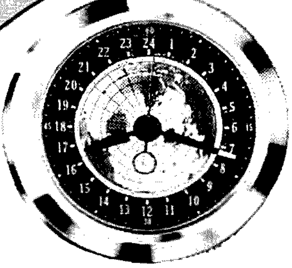

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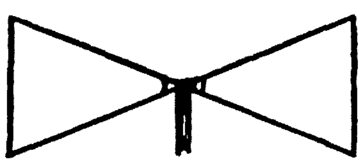

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As featured in Nov. 1958 QST. Complete with B & W 3013 Miniductor. Only 8 ft. long for 10 meters. Wt. 5 lbs.

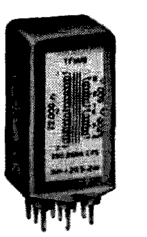
Amateur Net $7.85

COMANCHE SIGN

Controllable, illuminated sign that tells the XYL and guests you're transmitting. Cuts down background QRM. Can hook right into coil of antenna change-over relay for controlled "ON THE AIR" signal when XMTG. Heavy gauge all steel construction with handsome black or gray baked finish. Can be used on desk or tabletop or mounted directly on wall. Dimensions 18 1/2" long x 3 1/2" high x 3" deep. Specify desired finish in black or gray and operating voltage: 6 or 12 VDC, or 110 AC.

Amateur net $6.95

Versatile Miniature Transformer



Same as used in W2EWL SSB Rig — March 1956 QST. Three sets of CT windings for a combination of impedances: 600 ohms, 5200 ohms, 22000 ohms. (By using center-taps the impedances are quartered.) The ideal transformer for a SSB transmitter. Other uses: interstage, transistor, high impedance choke, line to grid or plate, etc. Size only 2" h. x 3/4" w. x 3/4" d. New and fully shielded.

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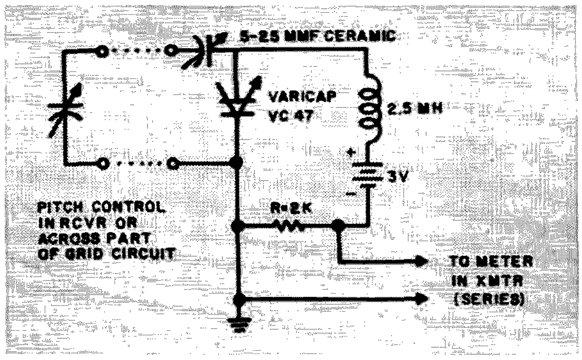
A Varicap Tuning Device For the Blind Operator

Robert E. Baird W7CSD
Box 2381 Oretech Branch
Klamath Falls, Oregon

FROM time to time various devices have been rigged up to make it possible for the blind operator to tune his transmitter. The basic problem is always to furnish an audible signal that will indicate maximum or minimum current normally noted visually on a meter. Since the advent of modern transmitters that switch a single meter, in many models with the meter on the ground side, to several circuits the problem has become less complex.

The unit to be described in this article centers around the Varicap and a few other small components. We will assume the transmitter to be used has a basic meter movement of O—1 ma, as this is very common. If such is not the case modify R to a value that will have about 2 volts IR drop across it for full scale meter reading. The following circuit will make operation of this device almost self evident.



With a maximum of 2 volts IR drop across R it can be seen the voltage applied to the Varicap will vary from 1 to 5 volts depending on the magnitude and polarity of the current to be measured. Since the voltage applied to the Varicap determines the capacity of the Varicap it will also tune the BFO of the receiver and hence change the pitch of the note if the receiver is tuned to any fixed carrier.

Operation

After the components have been installed in the receiver, tune to any fixed carrier. With the BFO turned on and pitch control tuned to midrange, adjust whatever parallel control there may be, (capacitor with screw driver adjust or variable slug) until the beat note zeros. The receiver is now back to normal. Now tune the pitch control 150 or 200 cycles on the high side. Plug the metering cord into the connection in transmitter which will put R in series with basic meter movement. Energize low power stages and turn switch to amplifier grid. If any grid current is being drawn at all the pitch of the BFO will increase. The higher the current the higher the pitch will be. Tune for maximum pitch which will be maximum grid current. Now turn switch to amplifier plate and tune for minimum pitch. Minimum pitch will indicate minimum plate current.

Note

In case it is not known which is the low or high frequency side or in case you wired the Varicap and battery using reversed polarity it may be desirable to get visual aid the first time. Which ever side will give an increase in pitch with an increase in current and a decrease in pitch with a decrease in current is the proper side to use. With a little practice a blind person will be able to tune as close by ear as others can by eye. Sensitivity is a function of how far off zero you tune the BFO and also the size of the variable ceramic capacitor in series with the Varicap. A little adjustment of both may be necessary.

The illustration shows the components in place directly on the grid of the BFO on an old HRO. Wiring would be equally simple on any communications receiver.

Caution

Don't try to use this circuit if your transmitter is metered in the high voltage side of the circuit.

Noise Clipper

Semi-Conductor Style

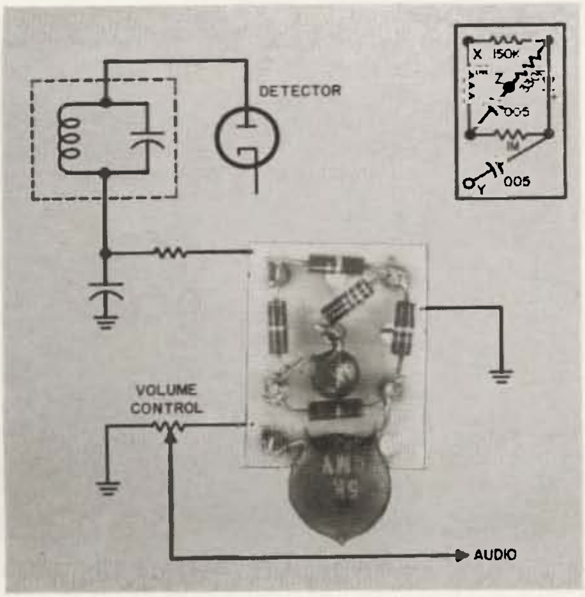
Al Newland W2IHW

WITH the current trend towards miniaturization and the attractive price of silicon diodes, we now can construct a small inexpensive semi-conductor noise clipper. As shown in Fig. 1, the pre-fabricated clipper is small enough to conveniently fit into a printed circuit type radio. If you do not care for the pre-fabricated version, you may wire the components in directly, as they are all small and self supporting.

In selecting the diode, we are interested in its back resistance and a value of at least 100 megohms is desired. The back resistance may be calculated by dividing the PIV by the back current. The two latter values can be obtained from the published characteristics of the diode. We mention the foregoing to prevent the builder from spending unnecessary time looking for the exact diode that we used.

It is suggested that the value of the capacitor C1 be found experimentally after the unit is in operation. A value between .001 and .005 is suggested. In the schematic, we show a .005. In the photo of the actual unit, a .001 is shown. Increasing the value will increase the clipping action. Excessive clipping will clip too much audio. If you desire to make provisions for switching the clipper in and out, a single pole single throw switch connected across the diode is satisfactory.

Note: The unit shown in photo is 1"x¾". 73



CUT THIS OUT!

Well, you don't really have to cut this page. What we want you to do is let us know which articles in 73 you found most interesting. Winner gets extra money and all that. Helps us give you what you like in the future too. Number at least the first five best liked articles.

——Translation
——Xsistor GDO
——Ian Interfer
——Superregen
——Debugging
——Top Loading
——CW Xmission
——All Band Ant
——Double PS V.
——Patch Patch
——432 mc Xsistor
——2M Xmtr
——Squawk Box
——Up Front
——Don't Bug
——Varicap
——Noise Lim
——80M DXing
——DC Meter Amp
——Motorola Test
——Propagation
——Sine YB
——Save-Learn
——File QSO's

Sam Harris W1FZJ, Chief Op at W1BU

80 Meter Phone DX

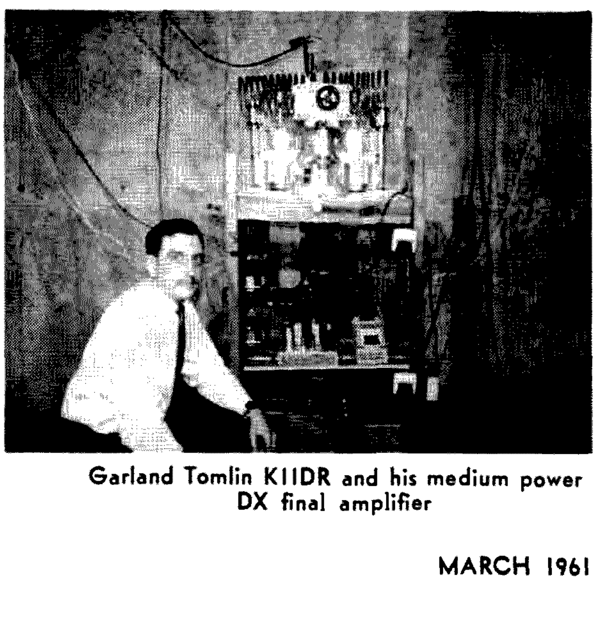
Fred Collins W1FRR
Microwave Associates, Inc.
Burlington, Mass.

"CQDX80." This is a familiar call heard on the low end of the 75 meter phone band during the winter season. Usually one thinks of DX on 75 meters to mean a contact two states away, but we mean a contact in excess of 3000 miles such as Europe or Asia or some far exotic country. In other words DX on 75 meters means the same as it does on 20 or 15. Working DX on 75 takes a special type of operation, if you want to work DXCC as fast as possible then you had better stick to 10, 15 or 20; but if you are interested in doing it the hard way, 75 is your band. If you are interested in working DX reliably, it is very desirable to have some sort of vertical antenna and medium to high power. Although when conditions are good almost any antenna configuration will produce excellent results.

A great deal of experimenting has gone into 75 meter DX antennas both for transmitting and receiving. To date the most satisfactory all-round antenna has been a sloping vertical antenna. In order to construct this antenna you must have one high mast preferably in the 100 foot region, and string a dipole towards the ground at a 30° to 40° angle. If necessary, because of limitations in height, the dipole may have loading coils at the ends. This type of antenna will be directive towards the low end with a front-to-back ratio of 15 to 25 db depending upon the angle of the received signal. It has been found that a true vertical has too low an angle for most 75 meter DX work. The standard 75 meter (quarter wave) high flat dipole under most conditions will do quite well.

Most of the European stations operate from 3780 to 3800 although if requested they will go down into the CW band about 3600 kc. The South African stations operate between 3690 and 3700. The New Zealand, Australia, Central and South American boys are apt to appear anywhere from 3600 kc all the way up to and including our phone band. For the most part the United States stations transmit between 3800 and 3830 kc on lower sideband. Most of this work is done on single sideband using lower sideband, but is not necessary limited to SSB as many of the DX stations worked are operating AM and have a good deal of success. A receiver with selectable sidebands, good selectivity and sensitivity is almost a necessity due to the very high interference on the DX stations frequency.

The received signals usually range from S1 to S8, therefore some sort of notch filter or Q multiplier is quite helpful in eliminating dead carriers and CW stations that appear in the form of interference. As far as eliminating AM or SSB interference there is not much



Garland Tomlin K1IDR and his medium power DX final amplifier

that can be done about it if it's in the passband except sharpen up the receiver and try to ignore it.

The European stations have been coming through in the late afternoon around 2100 GMT through 0800 GMT. When the Europeans start coming through it is still daylight here and of course it's well into the evening there. Because of this light and dark zone a type of one way skip is quite apparent. About one hour after sunset they are able to start hearing us. This one-way skip is caused by the number of times our signals must get reflected in the high absorption light area versus the long relatively low absorption dark area they are in.

The results obtained in the past few years' DX tests have been very gratifying indeed. W1BU worked WAC in the course of one evening thanks to 4X4DK appearing on 80 meters SSB. Early evening skeds have been held with GW3EHN, F7HC, GW5TJ and several other Europeans with good success. W1BU and W1FOS have been holding late schedules with G2HX, PAØFM, GW3EHN, G6VX, DI4PI, YV5ANS, ON4ZA, 4X4DK, UA1D2 and many other this last winter with only one or two exceptions. ZC4AK has been coming through from Cyprus with fair signals. ZL1ACG and ZL2AIX with good signals have been heard and worked consistently anytime after 0500 Z. ZS6AMV, ZS6AJH and ZS6KD have come through with fair signals.

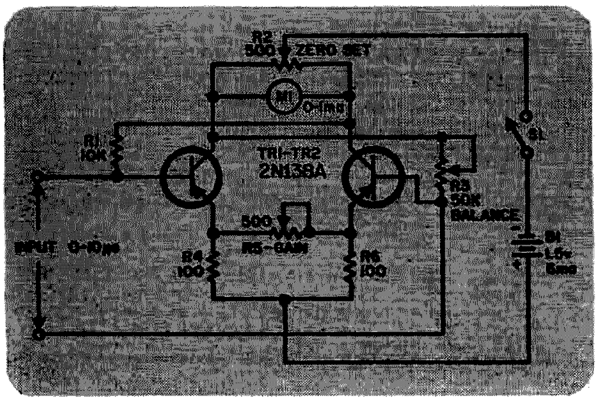
If your interest has been aroused and you don't mind working for your DX drop in on the low end of 75 and try your hand at it. We sure could use more DX stations on 80 phone. CU on 75. . . . W1FRR

A Transistorized DC Meter Amplifier

Roy A. McCarthy, K6EAW
737 W. Maxzim Ave.
Fullerton, Calif.

PRACTICALLY everyone has an inexpensive O-1 ma meter around the shack or in the junk box. By using this simple amplifier circuit the sensitivity can be increased to 10 microamps full scale, and the zero can be adjusted to the center or right end as well as the usual left end. By adding a few selected multiplier resistors and a range switch a voltmeter with 100,000 ohms/volt can be quickly assembled. Or, if used with the capacity meter in the October '60 issue, as low as 10 mmfd full scale can be measured. Field Strength meters also benefit by the addition of a linear current amplifier with a gain of 100.

The circuit is the familiar balanced amplifier, with the addition of both positive and negative feedback. The positive feedback obtained with R1 and R3 in Fig. 1 increases the gain of the circuit by a slight amount to compensate for transistors which have a bit less gain than desired. Negative feedback is provided by R4 and R6 and is controlled with R5 to set the gain to exactly 100. The two transistors are first selected as closely matched as is convenient for Beta and IcO. Further balancing is done with R3 and R2. R2 is also used to set the zero position of the pointer. The battery, B1, can be a regular or penlight flashlight cell, since the circuit is relatively insensitive to wide changes in the voltage. Zero drift with a temperature change from 75° F to 115° F was less than ten percent.



The transistors used were a pair of 2N138's with Beta of 130 and IcO of 6 uA. Other suitable types would be the Raytheon 2N467 or the General Electric 2N508.

An inexpensive trimpot was used for R5 since it is a "set and forget" control. A screwdriver adjust pot was used for R3 since it is also a set-up control. The zero set, R2, and the switch S1 are all that are required to be used in normal operation, and could be combined if desired. TR1 and TR2 should be mounted close together and away from any sources of heat if the amplifier is mounted in any existing vacuum tube gear. The meter used had a resistance of almost exactly 100 ohms. Use of meters with a different resistance may require adding a slight amount of fixed resistance in series in order to avoid changing the other circuit constants. Obviously the iron-vane type meters which require several volts for operation cannot be used.

Nothing is ever obtained free and the hidden price here is the increase in impedance. The circuit turned out to have an input impedance of 8400 ohms, as compared to the original 100 ohms of the basic meter movement. For a current gain of 100, we have the impedance increase of almost 100. Actual measured voltage sensitivity was 84 mv at 10 μa full scale, which is still much better than a popular 100,000 ohm/volt multimeter.

The initial set-up consists of setting R3 to approximately 10K, adjusting R2 to give an on-scale reading, then shorting the input and noting the reading. Remove the short, set R3 to the noted reading, then set R2 to zero the meter and apply a known current or voltage. A separate flashlight cell and a 300K ohm resistor will supply 5 ua. R5 is then adjusted to give the desired gain for 10 μa or $\pm$ 5 μa. The controls have some interaction so all adjustments should be repeated several times until the circuit is balanced and calibrated. The input impedance should be allowed for in calculating low voltage multipliers. 73

COAXIAL TYPE SWITCHES
...now available in single or multi-position

Now you can switch coaxial line circuits quickly and without error. These handy, inexpensive units are available with "UHF", "BNC", "N" and Phono type connectors for use with either 52 or 75 ohm lines. Phono connector types are specific for Hi-Fi applications. Other types are designed to handle RF Power up to 30 MC, 1 KW input.

Stock items ready for shipment are:

Model 550A—Single gang, single pole, 5 position switch with UHF connectors. Price: $8.25 each.

Model 551A—Single gang, 2 pole, 2 position special purpose switch with UHF connectors. Ideal for switching any device in or out of series connection in coax line circuits. Price: $7.95 each.

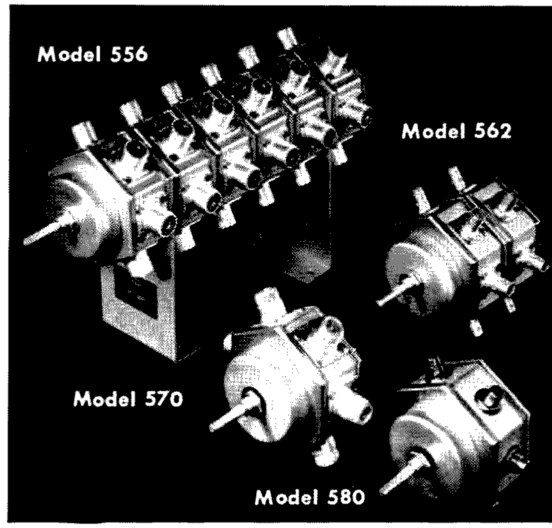
Model 560—Single gang, single pole, 5 position switch, same as Model 550A except with BNC type connectors. Price: $11.95 each.

Model 561—Single gang, 2 pole, 2 position special purpose switch, same as Model 551A except with BNC type connectors. Price: $9.95 each.

Model 570—Single gang, single pole, 5 position switch, same as Model 550A except with N type connectors. Price: $13.35 each.

Model 580—Single gang, single pole, 5 position switch, same as Model 550A except with Phono type connectors. Price: $7.35 each.

Multiple gang types, up to 6 gang for single pole—5 position switches, and as required for 2 pole—2 position switches, are made to order with any connector types listed above. Prices on request.



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- quality components used throughout assure dependability

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Model 505A or Model 506A, **wired,** factory tested **49.95**

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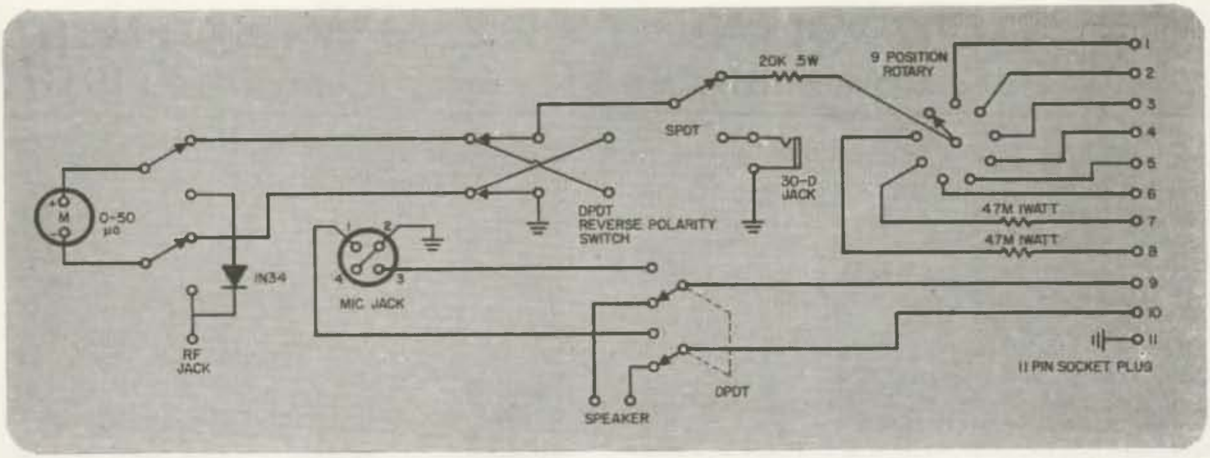
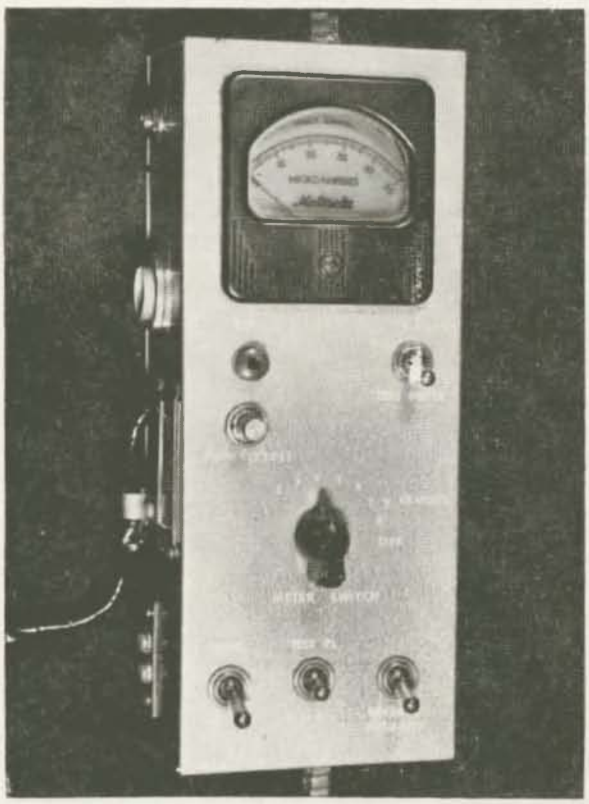


Motorola Test Set

Beryl Dassow W9HKA
RFD 2, Clifton, Illinois



THE unit pictured is a handy gadet to have around on one's workbench while converting the popular FM two-way radio surplus equipment to the six and two meter amateur frequencies.

This used out-dated commercial gear is drifting into our amateur channels in an ever increasing rate and a simple switch box is certainly a welcome addition for alignment checks. A regular test set can be obtained for something a little over $150, however this is usually out of the question even to most Civil Defense organizations.

The unit as described was designed with the idea of checking the alignment of the Motorola 30-D and 5V units of which our local CD is equipped. The older 30-D units provide a meter switch and all that is necessary is a good O-50 microammeter. However the 5V and later units provide a 11 pin test socket in both the receiver and transmitter sections for external meter switching and hence the need for the switch box arrangement.

Other features of this unit are the push-to-test switch, microphone jack and rf jack for overall check of the transmitter output.

Many other ideas will no doubt come to the reader's mind particularly those who have spent some time in converting these units. For example, a transistorized crystal oscillator could be wired in for checking purposes. The external speaker could be mounted internally by using a larger box.

While a meter movement of a higher basic range may be used with almost equal results, the O to 50 microammeter will give similar readings as described in the Motorola maintenance manuals.

(Continued on page 50)

Ham Headlines

If ham radio makes the newspapers in your town please send a clipping to Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Marvin runs the 73 News Service, a monthly publication sent to all editors of club bulletins. He will digest the most important stories that are submitted each month for us to print in 73.

HAMS AID BLIND BOY

(The Evening Bulletin, Providence, R. I., submitted by WIMUZ) H. Raymond Alexander, Sr., K1GRG, was the first to transmit an appeal for funds that would be translated into a receiver with Braille dials and knobs for a 12-year-old boy; Roy Sassi. Approximately $80 of the $600 sought has been raised to date for the fund which closely resembles a drive held about 2½ years ago, when a 9-year-old girl, requiring 136 skin grafts, received 2½ tons of QSL cards from well wishing hams.

BRITON HEARS RADIO WARNING TO SELASSIE

(Daily Mail, England, submitted by G2DHV) First news of the Ethiopian coup was received by John Turrell, G2CBN, on his 10 tube, eight year old, 25 pound receiver. Crashing through the chirping of Billy, John's budgerigar, came the message on 15 meters "CQ CQ de ET3XY. Inform his Imperial Majesty the Emperor now in Brazil, that a coup d'etat has taken place." Ethiopian officials in London were notified immediately.

HAM GUIDES DRUG TO CHILD IN BUENOS AIRES

(The Evening Bulletin, Philadelphia, Pa., submitted by J. Rosenwald, 2nd) Albert Fernandez, 41, of Croydon, picked up an emergency message being flashed over South America and came to the rescue of young Maria Graniselli, critically ill in hospital in Buenos Aires. Fernandez contacted a doctor in the Lower Bucks County Hospital, who in turn arranged to have a new antibiotic drug rushed to Argentina by air. Within 24 hours the girl had received the medicine and responded to it.

W6 ALERTS F.B.I. WITH ILLEGAL RIG

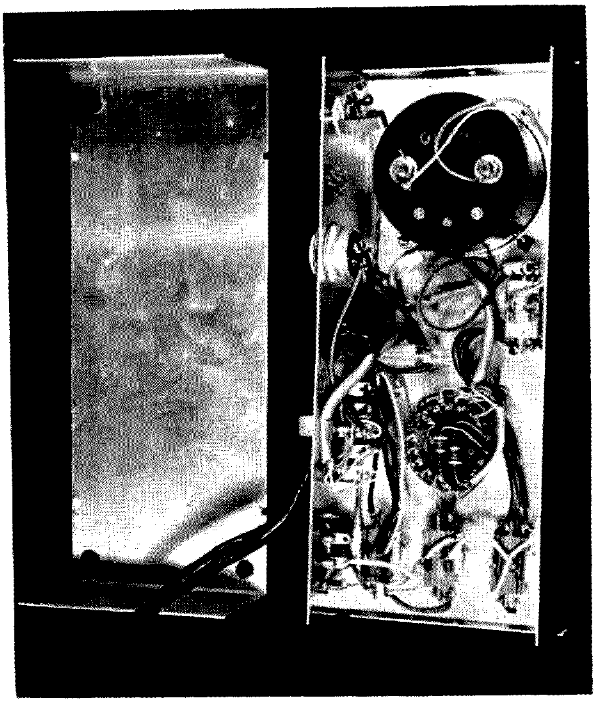
(San Diego Daily Press, Calif., submitted by Hugh Compton, W7MKW) James P. Green, 18, of San Diego, Calif., a freshman at College and ham operator planted an unidentified, radiating rig on Mt. Solebad causing a general alarm in the area. After a 5 day search by the F.C.C., C.D., and F.B.I., the intermittent signal source was located. The youth, who was not taken into custody, was quoted as saying that he hid the rig "to test our emergency network against enemy jamming." At last report the F.C.C. was considering punitive action regarding the misdemeanor. . . . VE3DQX

(Continued from page 48)

In order to determine which position of the selector switch corresponds to what section of the circuit under test, a small name plate holder is affixed to the side of the cabinet with the following information.

Receiver	Transmitter
#1—3rd IF Grid	Modulator Grid
#2—1st Limiter	1st Quadrupler Grid
#3—2nd Limiter	Tripler Grid
#4—Disc. (Sec)	1st Doubler Driver
#5—Disc. (Pri)	Doubler Driver Grid
#6—Multiplier Grid	P. A. Grid
#7—Blank	P. A. Plate
#8—Blank	B Plus

The actual method used in aligning these units is beyond the scope of this article. All parts are mounted as per the usual construction practices. The rotary switch as shown in the photograph happens to have more contacts than required but does afford an easy tie place for the two multiplier resistors.. These two resistors were simply selected to give approximately two-thirds scale reading when reading the high voltage. The 30-D to Test PL. switch needs only to be a SPDT instead of as shown in the photograph. The small fuse clips on each end of the box are used to hold the test plug cable when the unit is not used. 73



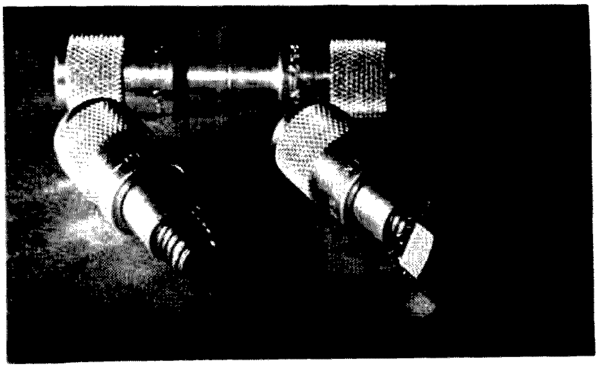
Parts List

1—0-50 microammeter.
3—DPDT Bat Handle Toggle Switches.
1—SPDT Bat Handle Toggle Switch.
1—SPST Momentary Push Switch.
1—9 position rotary switch.
1—Single circuit 'phone jack.
1—Banana Jack for RF input.
1—2-terminal board for external speaker.
1—11 pin socket (amphenol 78S11).
1—11 prong plug (amphenol 86-CP11).
1—4 contact mic. socket (amphenol 91-PC4F).
1—1N34 diode or similar.
1—20K ½ watt resistor.
2—4.7 megohm 1 watt resistors.
1—Minibox (10 x 4 x 2½).

Chassis Mounting the PL-259

THE UHF series of coaxial connectors, typified by the PL-259 plug and the SO-239 chassis receptacle, is widely used on both commercial and military equipment. Also, these fittings are still readily available, at reasonable cost, from surplus outlets.

It is often desirable to support small chassis mounted accessories, such as TR switches, by the coaxial connectors mounted on existing equipment. This generates a requirement for fittings that are not available as standard items. It is possible to mount later production PL-259 plugs on a chassis by using a standard National Coarse thread cap screw. A hex head, 7/16-14 brass bolt, about ½" long, is ideal for this purpose since the threads mate perfectly with the cable retaining threads in the plug body. A clearance hole for the connecting lead, up to 5/16" in diameter, should be drilled the length of the bolt. A lock washer should be used for secure mounting.



The second item that can not be obtained commercially is a double ended male plug. Such a fitting is ideal for mounting an antenna changeover relay directly on a transmitter antenna receptacle. A short stud, about 1" long, cut from a 7/16-14 brass bolt, serves as a perfect coupling for joining two PL-259 plugs. A clearance hole must be drilled the length of the stud to accommodate the wiring.

The photograph shows the assembly details of these fittings, along with the finished double male adaptor. This method of construction does much to alleviate the haywire maze of cables that always seem to complicate even the simplest installation.

. . . Pafenberg

New Products

. . . the editor

Anybody who thinks about it for a moment will realize that only in short-lived magazines do you find New Products reviews which tell you how terrible things really are. The normal function of the New Product Review is to inform the reader and butter the advertiser.

We endorse both of these policies and must also confess to a third: the editor likes to write about what is going on in the commercial end of our hobby, but doesn't want to upset advertisers by lumping everything in the editorial column.

The response has been so enthusiastic to some of our construction projects that little knots of amateurs have been gathering all around the country discussing the possibility of putting some of them on the market. One new company is called Gidgets and Gadgets, as unlikely a name as we've heard recently, and they're already putting out kits of parts for the W9DUT Bantam Converters and K8NIC's 6M Transmitter, both of the October issue of 73. They're hard at work getting some more kits ready. Just in case they run into any obviously lazy customers they have made arrangements with a couple of experts to wire the kits for a few bucks extra.

You might know that something would be brewing out California way along this line too. A call came in from P.G.B. Electronics saying that they were working along similar lines.

Irving Electronics, down Texas way, will be preparing printed circuit boards for any articles we run. Right now we're getting a p.c. noise limiter circuit ready for the next issue of 73. You ought to send for the catalog of p.c.'s Irv has available, you'll be amazed and enthused.

Can anyone tell us how in the devil Allied can sell a complete six meter transceiver, complete with mike, for only $57.50? It just doesn't seem possible! A superhet too.

I got to reading some of our own ads and the first thing you know I was driving over to visit Russ Spera W2UFU and talking deals over one of those URA-6 Teletype converters. After much haggling we settled on full list price and set about fitting the three racks full of gear in the back seat of the Porsche. Made it, but it was a tight fit. Now if there was only time to get it hooked up! I wanted to see Russ's stock of surplus, but the store was so full we couldn't even edge our way in to see what was there.

(Continued on page 52)

(New Products from page 51)

One of our inquiring reporters stuck their nose into Barry Electronics and discovered a couple interesting surprises. First of all the 1961 Barry Green Sheet is off the presses and is guaranteed to make any red blooded ham drool. This and the new International Crystal catalog rate as the best literature of the new year that we've seen for the home-brew type ham, excluding the 440 page reference work put out by Allied.

Alden Products informs us that several of our readers haven't yet bought their operating bench. This we can only ascribe to an oversight. You must have forgotten to send for literature and see what a deal they have. Or maybe you don't care what your shack looks like. This is one of the nicest operating tables we've ever seen.

Shure

A letter came rolling in the other day from Mr. H. T. Harwood, the Advertising Manager of Shure Brothers. Mr. Harwood explained that he had arranged to send me, compliments of Shure Brothers, and at the request of Bill Simons W9YXJ, a model 440SL Single-Sideband Microphone.

Well, here it was. I'd been fearing the day when someone would send something directly to me for a "test." I put the letter aside and tried to forget it. Then, a day later, it arrived. With a sinking heart I could feel all my altruistic plans disintegrating as cupidity took over. I wanted that microphone. I opened the box and screwed the mike to the stand . . . I had to have that mike . . . gad, what a beauty! I felt all the symptoms of drug withdrawal every time I even thought about sending this fabulous mike to someone who could do an adequate job of testing it.

The rationalizations came thick and fast. What kind of a test can anyone do on a mike anyway? About the best you can do is repeat the manufacturer's literature and give the output level and frequency range. Beyond that all you can say is that you used it on the air and the fellows said you sounded good. Shure would be satisfied with a simple new products release, I wouldn't even have to dummy up a "tested" report.

So far I had been able to avoid all this mental torture by having equipment shipped directly to other hams for them to test. As long as it didn't get into my hands I didn't feel too bad. Well, I felt bad . . . but I could stand it. There were times when it got rough . . . for instance when Don Smith W3UZN sent in a photo of his station with a Heath Tener, Sixer and Twoer all stacked on top of one another. That was traumatic. I really wouldn't mind other fellows getting all that gear free . . . if I just didn't know about it.

So here I am with a brand new desirable mike. I don't know why it bugs me so . . . after all, I already have a perfectly good mike that I've been using for five years now . . . a little Shure hand mike that I won out at the Dayton Hamvention in 1956. I suppose that I might part with the new one . . . probably give me nightmares. Tell you what, I'll put together a quick New Products Review for this issue of 73 and then we'll offer the mike as a prize to the sideband op that sends in the most subscriptions by April 5th. One catch . . . the winner has to use the mike on the air and send me a letter telling what the reports were on it. How's that? Boy! I feel better already . . . but gee, I'm sure going to miss that peachy mike.

New Books

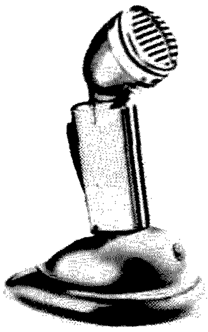
One of our most consistant contributors, Howard Pyle W7OE, has just become the proud author of a Sams Photofact book (NHP-1) called **"Building Up Your Ham Shack."** This is a fine book for the newcomer to our hobby for it will acquaint him with what he is going to need in the way of equipment and will put things into perspective. There is a chapter on receivers, one on transmitters and one on antennas. This is a well illustrated 128 page book and sells for only $2.50. This book will probably be available through most parts distributors and the Radio Bookshop.

Gernsback Library has just come out with a book that I would have really enjoyed when I was ten to fifteen. It is called **"Fun With Electricity"** and it has a bunch of experiments that you or your kid can have a ball with. The price is $2.65 (GL-83.) This shows you how to make a simple dc motor, an ac generator, a solenoid, a spark coil, a Tesla coil, etc. Literature like this around the shack might get more of a rise out of the jr op than anything else you've thought of.

Sams has a new book on **"Eliminating Man-Made Interference"** which will solve problems for a lot of hams. A lot of us run into this misery now and then and wish for some text to help us through the difficulty. This is the newest (and the only, to my knowledge) reference on the subject now available. $2.95. The book is quite thorough . . . 160 pages.

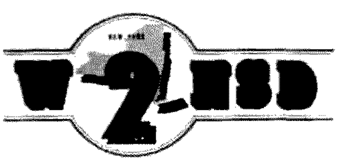
Another of our authors has been sneaking some time away from his 73 writing. The result, published by Sams, is the **"Second-Class Radiotelephone License Handbook"** by Edward Noll W3FQJ. The $3.95 book has everything you'll need to get the license. This is a lot more than the usual question and answer manual, with almost half of the book devoted to general information and technical discussion. The other half covers the actual exam and gives details on regulations. Thus the book not only will shepherd you through the FCC exam, but will give you practical operating and maintenance data to start you in the field.

New Shure Mike



Here is a mike that is designed specially for SSB ops. It has sharp cutoff below 300 cps and above 3000 cps, making it ideal for ham communications. It is rugged, being of magnetic design, and won't boil away in the sun or disolve when it rains. Output is —52.5 db at 100,000 ohms. For $28.50 the Model 440SL comes complete with grip-to-talk switch, mike stand and cable. Same deal, marked Model 440, less stand, switch and mike connector is only $15!

Call-D-Cal

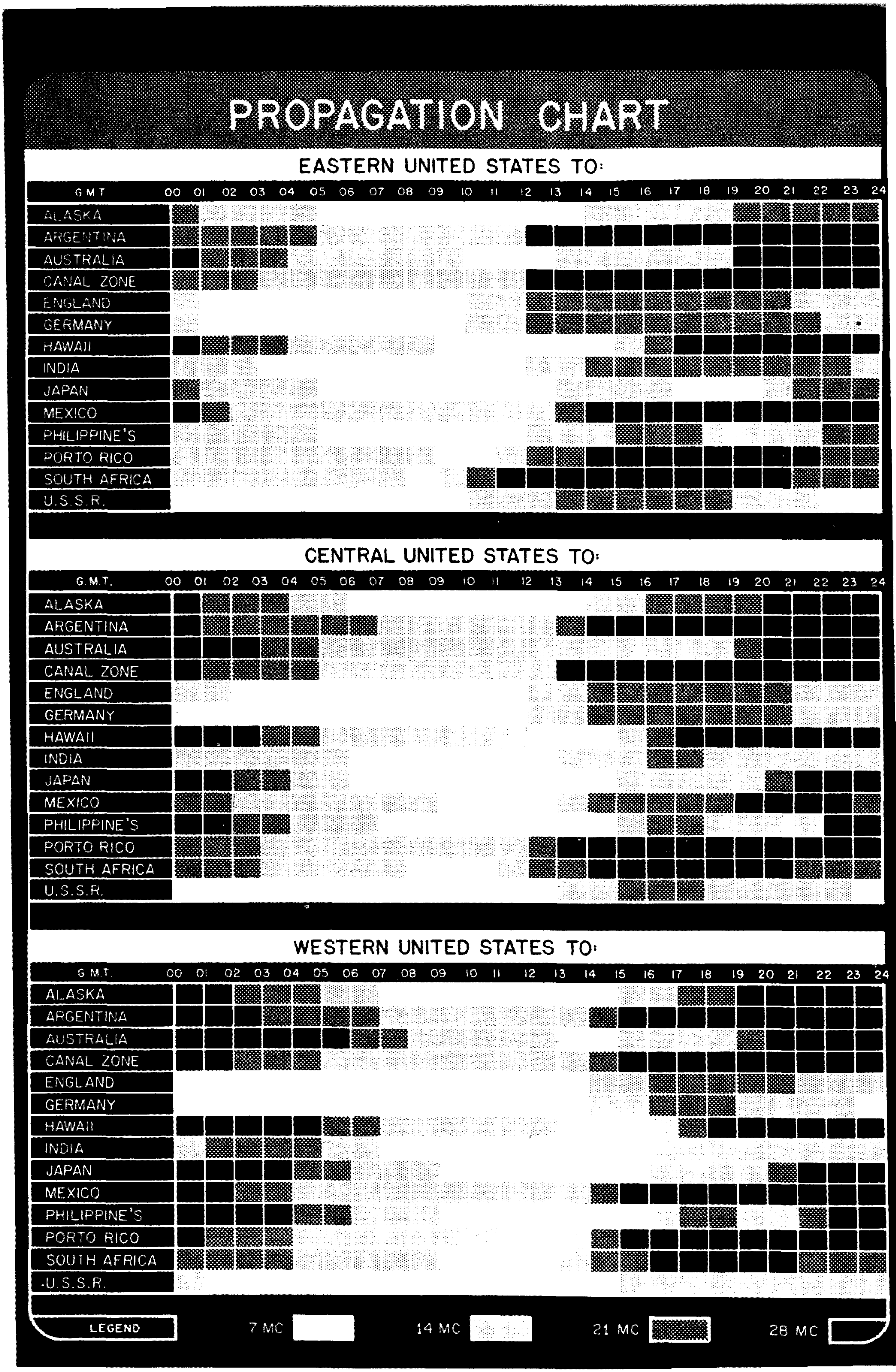


I've seen these decals advertised for the last few months, but I hadn't realized what a nice looking deal they really are. They are 8" long by 4" high and are beautifully colored: gold letters outlined in yellow, red number outlined in gold, and a blue state with a black shadow behind it. This will stand out fabulously on the rear window of your car. You can have a world design instead of your state if you wish. Price is only $1.95!

On The Air

One of the minor little jealousies down through the years between amateurs and broadcasters has been those little (and very expensive) signs which light up and announce you are on the air. No wonder then that there has been quite a rush to take advantage of a small outfit down Texas way that is offering professional-looking signs at Novice prices: $6.95 complete. These are professional enough so a lot of broadcasting stations have been laying in a supply. They are 10½" long, 3½" x 3" deep. You can get 'em with 6, 12 or 120 volt bulbs. For a dollar extra you can get your call letters instead of the "On The Air" message, or you can get it in some other language, or think up something clever of your own. All kinds of possibilities.

. . . W2NSD


PROPAGATION CHART
EASTERN UNITED STATES TO:
GMT 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PORTO RICO
SOUTH AFRICA
U.S.S.R.
CENTRAL UNITED STATES TO:
G.M.T. 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PORTO RICO
SOUTH AFRICA
U.S.S.R.
WESTERN UNITED STATES TO:
G.M.T. 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PORTO RICO
SOUTH AFRICA
U.S.S.R.
LEGEND
7 MC
14 MC
21 MC
28 MC

Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

The bands listed are MUFs and a higher band will not work for the time period listed. Lower bands will work, but not nearly as well. Times are GMT, not local time.

These charts are to be used as a guide to ham load openings for the month of March, 1961 to the various countries listed. I will be interested to hear of your results in using these charts and to know what other areas you might wish included in future charts.

Advanced Forecast: March 1961

All good except

Fair 5-6

MESSAGE TO NON-SUBSCRIBERS: S U B S C R I B E !

Distributors tell us over and over of the dozens of fellows who come in time after time looking for a copy of 73. Gloryowsky! If you would spend a fraction of all that effort and mail us a miniscule check you'd make both of us a whole lot happier. Back issues are getting scarce: include 50¢ each, while they last.

Name .... Call .... $3 yr.
Address .... $5 2 yrs.
City .... Zone ...... State .... $4 yr. DX
.... years. Start with .... issue.
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.... years. Start with .... issue.
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Names, 'Sines' and 'Handles'

Howard S. Pyle W7OE

". . . the handle here is Sebastian; what's your name old boy?" Bad enough on phone but imagine spelling it out on CW! Yet there are many just as tough to transmit and for the receiving operator to interpret. Names like Jim, Joe, Doc, Tom and even Bill and other simple one-syllable contractions aren't too bad but they too can be even simplified a bit. Intermediate names, generally of two syllables like my own, are not too much of a problem either but, particularly in CW operation, still a bit long to spell out. For example, ". . . handle here is Howard". Eighteen code characters to transmit. I seldom use it; my customary procedure is to say ". . . sine YB . . .". Only *six* characters but it tags me as an individual apart from my station call which is issued to cover the gear itself, *not* the operator! My *equipment* is W7OE; *I'm* not! I'm "YB", owner-operator of *station* W7OE. You wouldn't introduce a shipboard operator to someone by saying, "This is KURS (or whatever his call letter might be) would you? Nor a broadcast station operator by the call letters of the station at which he works. More properly, you would say, "This is Dick *of* KOMO". The same in ham practice; informal introduction of myself for example, would not be, ". . . this is W7OE"; correctly it would be something like this . . . "this is YB *of* W7OE". See the point? Nevertheless tradition and long usage has tagged the *individuals* with the call letters of an inert bunch of equipment rather than a more personal identification. Nothing wrong with it I suppose as the vast majority of ham stations are manned by only one operator who, in most cases, is the station owner as well. The practice will no doubt continue; it has gone on for too many years now to change overnight.

"Shades of Emily Post" some of you will say, "are you trying to tell us that we must observe formal social custom rather than the somewhat looser camaraderie of ham radio?" Not at all; handle it any way you like. All I'm trying to do is to point out a few usages in connection with individual identification which, while not necessarily confusing to the ham, can be improved upon both on-the-air and in face-to-face (I *hate* the expression 'eye-ball') QSO's. In addition, I'd like to attempt to clear up the apparent mystification which so many hams have when some relatively 'old-timer' casually says ". . . sine hr XX . . ." or some similar group of two letters. Let's find out what this "sine" business is all about . . . shall we?

As far as I can determine (I'm not *that* ancient, you know!), it all started shortly after Sam Morse invented the electric telegraph in the middle 1800's. Messages were soon flying (well, stumbling anyway!) along the thin copper threads stretched from pole to pole and from city to city. As the telegraph began to prove increasingly practical and speedy, messages became of increasing importance. Often messages were filed which dealt with impressive transactions, financial and otherwise. An improperly sent or received message could, and frequently did, involve serious losses to either the sender or recipient or both. Often the telegraph company had to 'take the bump' in the way of lawsuits which very often proved plenty costly. They in turn cast about for some means of recovery from the operator or operators on their circuit who were responsible for errors in transmission or reception or both. But *what* operator(s)? Telegraphers changed shifts, swapped around and added to the confusion of identification in other ways. Recovery of any financial loss from an operator due to his error was, of course, a rather forlorn hope on the part of the telegraph company. Telegrapher's pay was low and, in the early days, a good many of them were "drifters" and pretty good examples of the old adage, ". . . a rolling stone gathers no moss . . . ". Nevertheless the telegraph companies decided to attempt to do something about it; thus the "sine" was born. Where the spelling originated is anybody's guess. It is pretty obvious thought that 'sine' was probably a contraction, speaking code-wise, of the word 'sign'. You 'sign' a receipt, a letter, a check and by so doing acknowledge it. Telegraph operators were required to sign for each message received by making their 'signature' in code characters. The *sending* operator was required to place *his* signature on the face

of each message he transmitted.

Often, signatures were long . . . you know, "George Washington, Evelyn Belideau, Ben Franklin . . . " (had they been operators) took valuable circuit time to write. It was not long before merely the *initials* of the operators were substituted. Often this caused confusion where two or more operators in the same office might have the same initials. To offset this, a couple of letters which did not conflict with others, were arbitrarily selected. George Washington might remain 'GW' without conflict, but maybe Evelyn's initials (EB) might clash with Ed Baker's. So . . . Evelyn probably became 'EV' while Ed retained his 'EB'. Maybe Ben Franklin kept his but he could conceivably have run into Bob Freeman who was already using 'BF' as a 'sine'. One or the other changed; usually the junior man at that office. Whatever they turned up with became the operators' signature or 'sine'; the contraction from 'sign' to 'sine' saved two dashes in transmission when some operator asked for your sign or merely said "WO" which, in telegraphic phraseology, sent on Morse lines as 'dit dah dah; dit space dit' (in continental code it's 'dit dah dah space dah dah dah) meant "Who ?".

The practice of arbitrarily selecting a group of two letters, your initials or otherwise as circumstance dictated, soon achieved international recognition as telegraphic 'signatures' in the operating field. An operator kept his 'sine' throughout his telegraphic career regardless of where he moved. *Unless* . . . he accepted a job at an office where some other operator was already using the same sine. In such cases, they squabbled it out among themselves and the office manager based mainly on who had held the sine the longest! When the losing operator moved on to some other office, he generally retrieved and used his temporarily lost sine.

When I started my Morse telegraph career as a student telegrapher in the Portland, Oregon main office of Western Union in 1916, my initials (HP) were already in use as a sine by a senior man. Being junior, it was incumbent on me to pick a sine not then being used. I chose "NX" as I liked the rhythm; NX in *Morse* code is the same combination of dots and dashes which make up the letters "NL" in Continental or International radio code.

Radio had always been my first love. Starting as a radio (or "wireless" as we then knew it) ham in 1908 at the tender age of ten years, the romance of the air waves continued to intrigue me. A Morse telegraph office to me was a humdrum of routine; same old place, same old faces every shift. I didn't stay long as a wire telegrapher. A shipboard job opened for which I could qualify as I had meanwhile acquired a commercial radio operator license. I snagged the job and took my sine with me . . . NX. Liking the rhythm of the *Morse* NX, I used the same characters; "dah dit dit dah dit dit". Using the Continental or International Morse code in the radio service, this combination of characters became "NL". That was it; NL became my sine in 1917 and stayed with me during merchant marine operating, at Naval radio shore stations and during a year on a Naval transport between the United States and Europe, during World War I. Mustered out of the Navy after the 1918 armistice, I returned to the merchant marine in the Alaskan passenger service, still keeping NL as a sine. Still later, as operator at a commercial shore station (KJA) at Jualin, Alaska, NL was still with me.

In the fall of 1919 I returned to Naval service and was assigned duty as an operator at the naval 'high-power' station, NVH, at Ketchikan, Alaska, still carrying NL as my sine. Trouble developed on my first watch! No one else on the station was using the same sine but the Ketchikan station, in addi-

tion to handling much of the official naval traffic for Alaska, also handled a great deal of commercial radio message traffic to the territory (then, before statehood), sharing this with the Army Signal Corps cable and radio system. This involved the conventional 'fast' messages, day-letters and night-letters. The designation for a night-letter were the letters 'NL' following the check. Each time I'd OK for a message received from our sister station, NUZ, in Astoria, Oregon by using the standard form, "R NL" (meaning received OK by operator NL), I'd get a beef from the Astoria operator to the effect ". . . no, no; that's not a night-letter; it's a 'black' (fast) or a day-letter". Obviously my sine must be changed. I determined this time to choose one which had only a remote chance of duplication in my future operating career. Thus was "YB" born. I have since served as operator aboard many freight and passenger vessels and at a number of commercial shore stations. I have *never* since choosing "YB" for a sine in 1919, been in conflict with the sine of any other operator! I still use it in ham nets and in general ham communication, without challenge. I am in fact, known better in ham and commercial radio circles as "YB" than by my formal name. To answer the many mystified inquiries which I receive, the letters 'YB' do *not* stand for anything in the way of actual words. Call them "young boy", "yellow belly" or "you b - - - - - d" as you prefer but they have *no* real association with *words*. Like "SOS" which means 'distress'; *not* "save our ship" or "send us succor" and similar phrases invented by an imaginative lay public, "YB" means *me* as an individual!

I would most certainly encourage more frequent use of sines, self-chosen, on ham circuits, particularly CW. It shortens the number of characters in almost every instance and immediately identifies you as an individual. There are a few exceptions, of course such as using the nicknames 'Ed', 'Al' and similar. Nothing wrong with them for a sine; most certainly they are short enough although, as names go, rather common. Pick yourself a combination of two characters which appeal to you for perhaps rhythm, ease of sending or ready interpretation; make those two letters your sine and become known by them. You can drop the 'handle' or 'name' business then and do a more professional job of operating, even in the ham bands.

And that, dear reader, is that; I do hope it clears up the oft repeated question of 'what is a sine?'.

"73" de "YB"

Other Ham

RATHER than devote half or more of 73 to the printing of news of interest to specialized groups we believe that it is our function to do everything possible to encourage the publishers of bulletins which cater to these

HAM-SWAP. Published by Ham-Swap, Inc., 35 East Wacker Drive, Chicago I, Illinois. Editor is Ed Shuey, K9BDK. Subs are $1 per year by 3rd class mail, $3 for Ist class, $5 airmail, and $7.20 special delivery. Published once a month. Contains classified ads entirely. This is your best bet for an inexpensive way to sell or swap some gear in a hurry. Within two weeks people are answering your ad.

FLORIDA RTTY BULLETIN. Fred W. DeMotte W4RWM, P.O. Box 6047, Daytona Beach, Florida. $3 per year including membership in Florida RTTY Society. Mostly operating news with a bit of technical info now and then. All TT men should be getting this.

SOUTHERN CALIFORNIA RTTY BULLETIN. Merrill L. Swan W6AEE, 372 West Warren Way, Arcadia, California. $2.75 per year, not including membership in Society. Operating news and some technical articles. This is the oldest TT bulletin going. All TT men should also get this one. Monthly.

73 HAM CLUB BULLETIN. Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Sent free to all editors of ham club bulletins monthly to keep them abreast of what is going on with all the other ham clubs. This is an excellent source of news for putting together your club bulletins. To subscribe to this news bulletin just send a copy of your own club bulletin to Marvin.

WESTERN RADIO AMATEUR. Don Williamson W6JRE, 10517 Haverly Street, El Monte, California. Monthly. Subs are $2 per year, $3.50 for two years, $5 for three years. Operating news of west coast activity, columns on DX, SSB, YL, and some articles. 48 pages.

SIDEBANDER. Official organ of the Single Sideband Amateur Radio Association, 12 Elm Street, Lynbrook, L. I., N. Y. Subs include membership to SSBARA: $3 per year. Monthly. Primarily operating news and chit-chat for the SSB DX gang.

Publications

interests. These bulletins bring you the news you want in far greater detail and in much less time than is possible in a monthly magazine where it usually takes two months for news to get into print.

THE OLD TIMER'S BULLETIN. Published by Bruce Kelly W2ICE, Main Street, Holcomb, New York, four times a year. $1 per year. Pictures and discussions of old ham gear, old ham ops and old ham doings.

HAM-HOP NEWS. Published quarterly by the International Ham-Hop Club, G. A. Partridge G3CED, 17 Ethel Road, Broadstairs, Kent, England. 75¢ per year for bulletin, $1.50 full membership. Club devoted to arranging visits between hams and ham families all over the world.

VHF AMATEUR. Published monthly by Bob Brown K2ZSQ(T), 67 Russell Avenue, Rahway, New Jersey. $2 per year. Operating news for VHF'ers.

THE MONITOR. Mar-Jax Publishers, 507 West Davis Street, Dallas 8, Texas. $1 a year, 3 years for $2.50. Monthly. Largely operating news. Columns: YL, Club Meetings, Arkansas News, Mississippi News, Florida News, DX, Missouri News, MARS, California News, Louisiana News, VHF News, Oklahoma News, Rio Grande Valley News, Novice News.

DX-QSL News Letter. Clif Evans, K6BX, Box 385 Bonita, California. Published quarterly. 40¢ each; Annual subscription $1.25 (four copies) by first class mail ($1.50 for DX stations). Lists all QSL Bureaus, managers for rare DX stations, etc. Why not send your old Callbook to a DX ham? Write Clif for the name of someone who needs it.

DIRECTORY OF CERTIFICATES AND AWARDS. Clif Evans, K6BX, Box 385, Bonita, Cal. Complete Directory plus one year of revisions (quarterly) $3.50. Add 75¢ for 1st class mail; $1.25 for airmail; DX stations 1st class mail add $1.00. Needless to say, this is the most complete collection of data on the hundreds of certificates and awards available.

MOBILE NEWS. Published monthly by the Amateur Radio Mobile Society, 79 Murchison Rd., Leyton, E. 10, England. Joining fee and 1 year sub. is $2.50.

DX BULLETIN. Don Chesser W4KVX, RFD 1, Burlington, Kentucky. DX news in depth. Published weekly. 3rd Class mail $5 year; 1st class $6; Airmail $7.50. DX rates on request.

Radio Bookshop

GOOD GRIEF, don't you ever get the yearn to learn? RB shipping dept. is anxiously awaiting your slightest stir. You know, if you buy one book a month you might end up with a fairly decent reference library? By the way, RB policy has always been Money Back, no questions asked.

1—ELECTRONICS & RADIO ENGINEERING—Terman. One of the most complete text books ever printed. 1078 pages. Theory, but easy on the math. $15.50

2 — ELECTRICAL ENGINEERS' HANDBOOK — Pender-McIlwain. This huge book should keep you busy for months just reading the interesting facts it contains. There is hardly any problem in communication or electronics that you can't find covered here. Excruciatingly thorough. 1618 pages. **$10.00**

5—ANTENNAS—Kraus (W8JK). The most complete book on antennas in print, but largely design and theory, complete with math. $11.50

6—VACUUM-TUBE CIRCUITS AND TRANSISTORS—Arguimbau. Designed for both beginners and engineers. Math kept to a minimum. Simple explanations of complex ideas. You'll know a lot more about radio after you read this book. 646 pages. **$10.25**

8—RADIO-TELEVISION & BASIC ELECTRONICS—Oldfield. Logical presentation and descriptive illustration make this an ideal book for the beginner. Written by self-learning of electronics principles. 342 pages. $4.95

10—1, LIBERTINE—Shepherd (K2ORS). Racy 35¢ book, a best-seller. Specially priced for you at . . . 50¢

13—REFERENCE DATA FOR RADIO ENGINEERS. Tables, formulas, graphs. You will find this reference book on the desk of almost every electronic engineer in the country. Published by International Telephone and Telegraph. **$6.00**

16—HAM REGISTER—Lewis (W3VKD). Thumbnail sketches of 10,000 of the most active and well known hams on the air today. This is the Who's Who of ham radio. Fascinating reading. **$5.00**

20—RTTY HANDBOOK—Kretzman (W2JTP). A-Z of ham Teletype. Very popular book, low supply. $3.00

21—VHF HANDBOOK—Johnson (W6QKI). Types of VHF propagation, VHF circuitry, component limitations, antenna design and construction, test equipment. Very thorough book and one that should be in every VHF shack. $2.95

22—BEAM ANTENNA HANDBOOK—Orr (W6SAI). Basics, theory and construction of beams, transmission lines, matching devices, and test equipment. Almost all ham stations need a beam of some sort . . . here is the only source of basic info to help you decide what beam to build or buy, how to install it, how to tune it. $2.70

23 — NOVICE & TECHNICIAN HANDBOOK — Stoner (W6TNS). Sugar coated theory: receivers, transmitters, power supplies, antennas; simple construction of a complete station, converting surplus equipment. How to get a ham license and build a station. $2.85

24—BETTER SHORT WAVE RECEPTION—Orr (W6SAI). How to buy a receiver, how to tune it, align it; building accessories; better antennas; QSL's, maps, aurora zones, CW reception, SSB reception, etc. Handbook for short wave listeners and radio amateurs. $2.85

28—TELEVISION INTERFERENCE—Rand (W1DBM). This is the authoritative book on the subject of getting TVI out of your rigs and the neighbors sets. $1.75

32—RCA RADIOTRON DESIGNERS HANDBOOK—1500 pages of design notes on every possible type of circuit. Fabulous. Every design engineer needs this one. $7.50

33—WAVE PROPAGATION & ANTENNAS—Welch. Highly recommended by the propagation experts as the best Book on the subject. **$5.75**

40—RADIO HANDBOOK, 15th EDITION—Orr (W6SAI). This is far and away the best amateur radio handbook ever printed. Over 800 pages. $8.50

49—ELECTRONIC COMMUNICATION—Shrader. Everything you need to know about electronics, electricity, and radio to pass FCC amateur or commercial license examinations. This text has what you hoped to find in the Amateur Handbook: detailed thorough explanations of every phase of radio and electronics. 937 pages. This is one of the few really complete texts on the subject. **$13.00**

50—MICROMINIATURIZATION—This is the standard text on the subject. Don't see how a company library can be without this one. Everything is going to have to be built smaller, you know. $11.00

52—HOW TO READ SCHEMATIC DIAGRAMS—Marks. Components & diagrams; electrical, electronic, ac, dc, audio, rf, TV. Starts with individual circuits and carries through complete equipments. $3.50

53—BASIC ELECTRONIC TEST PROCEDURES—Turner. This book covers just about every possible type of electronic test equipment and explains in detail how to use it for every purpose. Testing: audio equipment, receivers, transmitters, transistors, photocels, distortion, tubes, power . . . etc. $8.00

55—TRANSISTOR CIRCUIT HANDBOOK—Simple, easy to understand explanation of transistor circuits. Dozens of interesting applications. $4.95

56 — RADIOTELEPHONE LICENSE MANUAL — Smith (W6BCX). One of the editors of the old "Radio" has done a beautiful job of presenting study material in this Q & A license guide. Even if you are not going for your commercial ticket, which is accepted as proof of technical knowledge, you may want to use this manual to keep track of how far you have progressed in radio theory. **$5.00**

57—QUAD ANTENNAS—Orr (W6SAI). Theory, design, construction and operation of cubical quads. Build-it yourself info. Feed systems, tuning. $2.85

58—ANTENNAS FOR CITIZENS RADIO—Orr (W6SAI). General coverage, mobile and directional antennas for 27 mc. band. Build & tune 'em. $1.00

69—S-9 SIGNALS—Orr (W6SAI). A manual of practical, detailed data covering design and construction of highly efficient, inexpensive antennas for the amateur bands that you can build yourself. $1.00

72—ABC's OF HAM RADIO—Pyle (W7OE). Designed for the Novice ham. Includes all of the information needed to qualify for the Novice License. 112 pages. $1.50

74—HANDBOOK OF ELECTRONIC TABLES & FORMULAS—Formulas & laws, constants, standards, symbols and codes. Math tables, misc. data. $2.95

75—BUILD-A-WARD QSL ALBUM—Mount your prize QSL's in this album. Room for 100 cards in each album plus labels for just about all possible operating awards. A fine way to show off your cards. $1.95

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In recent years the myth that *it's cheaper to buy than to build* has been gaining acceptance as fact among a great many radio amateurs. Thanks to the prosperity which our country now enjoys, a large number of U.S. hams can afford to purchase the ultimate in chrome plated kilowatts, precision receivers and deluxe beam antennas. While attempting to emulate these fortunate fellows, less affluent hams resort to all sorts of ludicrous rationalizations in order to salve their consciences for spending so much on what is, after all, only a hobby.

Ozzie (short for Ostrich) Ham, the one who prefers to bury his head in the sand rather than to look at unpleasant facts, will tell you that his new rig set him back only $200. He neglects to mention that he had previously paid $150 for the transmitter he traded in on the new one and he happily ignores the $20 to $30 carrying charges he's going to donate to the finance company as part of his time payment.

Trade-in Tommy has convinced himself that, in the long run, home-brew equipment costs a lot more than factory built gear. He points out that nowadays it is very difficult to locate a buyer for a used composite rig. Furthermore, a dealer won't even consider such equipment as a down payment on a factory produced transmitter. Tommy prefers to overlook the fact that the parts from an old home built rig either find their way into a new transmitter or else they are stored in the junk box for future use. True, these parts won't bring much at resale, but to the ham who owns them they are just as good as money in the bank. Maybe even better, if you weigh inflation caused price advances against bank interest rates.

Cautious Kenneth naively assumes that a kit or a factory wired piece of equipment is bound to put out a superior signal that won't get him in trouble with the FCC. While this is usually true, a poor quality signal can be generated by a rig carrying a famous manufacturer's label. A friend of mine, for example, owns a $400 transmitter that wobbles all over the place when amplitude modulated on 40 meters. Another fellow I know also has one of these beautifully styled instruments. Because of TVI, he was put off the air by a visiting FCC inspector.

Almost every case of really objectionable splatter I've heard on the phone bands in the last 3 or 4 years has resulted from over modulation of one very popular transmitter model. Another well known product puts a truly obnoxious signal right in the middle of the 160 meter Loran assignment when it is supposedly tuned to 75 meters. So you see, even though a lot of engineering know how is behind the design of a commercial rig, now and then somewhere along the production line somebody goofs.

High Power Harry bought his costly commercial rig because it is rated at 2000 watts PEP. An old time AM'er, Harry didn't read the fine print which claims an output of only 300 watts on that mode of transmission.

Hurry Up Hal says he's too busy to build. He just can't stay off the air long enough to roll his own. Hal's forgotten that it's possible to derive a great deal of satisfaction from creating something with a soldering iron and a screw driver. In fact, building can be just as much fun as yakking on 75 with the natives of New Haven, Nashville or Nutley.

If you've read this far, you've probably concluded that I'm one of those miserable old die hards who spends most of his time writing nasty letters to ham magazines about the bumper crop of knob twisting nitwits who inhabit the amateur bands these days. On the contrary, I believe it is a privilege to live in a country where so many individuals can truly afford the finest manufactured equipment that money can buy. Furthermore, I'm proud that my chosen hobby is one which provides year 'round pay checks to hundreds of Americans who are employed by receiver, transmitter and antenna manufacturers. However, I do feel that a lot of newly hatched hams, the kind who've never wound a coil, held a soldering iron or built a beam, get too little pleasure for each dollar they invest in the radio game.

If you have a well padded bank account or if you live in a small apartment or a house

trailer where you can't find room to set up a modest workshop, factory built gear obviously is the answer to your requirements. On the other hand, if you must think twice before spending a dollar and if you can locate enough space for a small workbench somewhere in your home, I contend that it will pay you to consider the advantages of building as much of your ham gear as possible. What are these advantages? Among the more important ones are the following:

WHEN YOU BUILD IT YOURSELF YOU INCREASE YOUR STORE OF PRACTICAL KNOWLEDGE.—Some hams attempt to lord it over their Citizens Radio brethren by boasting of the difficult theoretical examination which must be passed before a license is granted. Actually, though, just about any halfway intelligent human being has the ability to memorize the contents of the *License Manual* and squeak by the amateur exam with a passing grade. In view of this fact, it is hardly surprising that so many amateur operators know little more about what goes on behind the front panel of a transmitter than do their mail order counterparts on the Citizens Band.

You can read all kinds of text books. You can commit to memory every word in the instruction manual that came with your commercially built rig. Nevertheless, until you've actually worked with parts and have assembled them into a properly functioning electronic device, you can hardly claim to be a well rounded master of the amateur radio art.

A ham who doesn't build is analogous to a chemistry or physics major who has never been inside a lab. It's true that the answers to most technical questions will be found in books. However, if you discover the answers while actually working with a rig you've constructed, yourself, the information you glean will take on added significance and will really stick with you.

As the home constructor assembles an electronic gadget, one piece at a time, he becomes familiar with the location of each part in his rig. During the debugging process which usually follows the completion of home built gear, the experimenter learns the effect of a little more resistance here, a smaller coil there, etc. He gets the feel of his equipment and therefore doesn't hesitate to dig in when something needs to be repaired. Unlike many "buyers," a "builder" is seldom overawed by the complex wiring so often encountered in today's receivers and transmitters.

HOME BUILT GEAR CAN BE MADE TO OUTPERFORM SIMILARLY PRICED COMMERCIAL

EQUIPMENT.—Mass produced items must, of necessity, contain compromises between performance and price. Here is where the hobbyist has a distinct advantage. His labor costs nothing and if he's ingenious, he can hold component cost to a relatively low figure. Take for example VFO's. I've wired up two different VFO kits and have extensively experimented with a third. Not one of these approached in performance (mechanical and electrical stability, ease of tuning) a VFO which I built, myself, at a cost approximately equal to that of the least expensive kit.

I know a fellow who wanted an antenna with so much gain that it would put him way above the QRM and would provide consistent QSO's, even under the most adverse conditions. He had to build it, himself, because there is nothing in the catalogs that can approach its performance. You see it's a 10 meter Quad—with *twelve* elements.

HOME BUILT GEAR CAN BE TAILORED TO YOUR SPECIFIC NEEDS.—I wanted an effective beam that would cover 10, 15 and 20 meters. Because of nearby tree branches, no element could exceed 18 feet in length. Out of respect to my flimsy mast, the weight, including rotator, couldn't be much more than 10 pounds. To top off my requirements, the radiator, director and reflector must be tunable, by remote control, from the shack. The finished product met every one of my specifications at a cash outlay of less than ten dollars.

THE HOME CONSTRUCTOR NEED NOT PAY FOR UNNECESSARY FEATURES.—In order to please the varied tastes of prospective buyers, a manufacturer must include as many features as possible in the gear he markets. This may make for versatile performance, but it also adds to the selling price. I'm not interested in RTTY so why should I pay to have FSK built into my rig? I don't like VOX. For this reason, when I built my SB rig, I left out this annoying (to me) feature. The money I saved by the omission helped pay for other features that I wanted to include.

A FELLOW WHO BUILDS OBTAINS EXTRA PLEASURE FROM HIS HOBBY.—Whether you follow a circuit that has appeared in a magazine or design your own rig from scratch, once you have it completed and on the air, you'll experience a feeling of accomplishment that can never be enjoyed by the fellows who buy kits or factory wired gear. When a far off station comes back to a call from "your baby" you'll be filled with a pride that must be experienced to be appreciated. And when nontechnical visitors come to the shack you can rightfully boast that "you made it, yourself."

HOME CONSTRUCTION GETS YOU OUT OF THE STEREOTYPED QSO RUT.—Have you really listened to the kind of QSO's that are prevalent today? A typical transmission goes something like this: "Rig hr's an FV300 feeding an NG47 beam with an XX22 for a hearing aid." That's all there is to it. No more description of the layout is required, because everyone knows just what these mass produced items look like.

When the home constructor goes on the air, however, this is not the case. Each piece of gear he's put together is a custom job. Even though much or all of it may have been copied from a similar unit, no other ham gadget is exactly like it. Consequently, a thorough over the air description is in order. This takes time and before you realize what is happening, a good old fashioned rag chew is in progress, since the boys involved are doing more than just spouting model numbers.

THE FELLOW WHO BUILDS HIS OWN DOESN'T SHY AWAY FROM CIRCUIT CHANGES.—The owner of a commercial unit seldom cares to make revisions that might adversely affect the resale value of his equipment. On the other hand, a home constructor has no such qualms. Whenever he wants to improve performance by trying out a new circuit, he merely plugs in his soldering iron and goes to work.

IT COSTS LESS TO BUILD THAN TO BUY.—Undoubtedly the most important reason for constructing your own ham gear, as far as the fellow with a thin billfold is concerned, is that by so doing you can save money.

About a year ago I decided to up-date my rig by adding a bandswitching final for CW, AM and SB. The amplifier I built is capable of 1000 watts PEP input as a linear. In Class C service it is rated at 500 watts CW and 400 watts phone. From the time I first thought of building the amplifier, until I had it completed and on the air, I paid out less than $8.00 for new materials. All the rest of the parts came from my junk box. Using today's ham logic, the entire amplifier cost me less than a penny a PEP watt.

Actually, some time in the past, I had to pay for most of the parts I took from the junk box. Thus, in order to fairly evaluate the total cost of the amplifier, the original amount paid for all components probably should be figured in. When this is done, the price tag reads $27.94. Even if I didn't have a junk box to rely on and had found it necessary to purchase every part

new from a current catalog, the price of the linear would be only $95.00. This is somewhere between ⅓ and ⅙ of the cost of a kit or factory wired amplifier with similar characteristics.

The true home builder, of course, seldom buys all of his parts at 40 and 2 off list. Instead, he is constantly on the lookout for bargains. He picks up usable tubes and transmitter components for a fraction of their original cost at ham club swap and shop sessions. He cannibalizes war surplus equipment for needed parts. He purchases small items such as resistors and capacitors in kits or by the pound. He carefully scrutinizes the ads in the back pages of ham publications while searching for low priced items. Even through the heyday of surplus, with its 50¢ beam rotators and 79¢ 304TL's is long gone, a fellow with a sharp eye can still save plenty of money when buying material for equipment construction.

WHAT ABOUT APPEARANCE?—Many home constructors lack the shop facilities and mechanical know-how required to give their gear that sleek factory styled look. This is, however, a rather insignificant drawback, because the fellow on the other end of a QSO isn't interested in the appearance of your rig. All he cares about is how it sounds over the air. By observing the rules of good engineering practice, the home constructor should be able to produce a rig that rivals or even excels the performance of the average piece of commercial gear.

Of course there is no law which says that home built equipment must have an amateurish look about it. Take the case of one of my friends. Although he owns a top notch commercial kilowatt, he still enjoys building accessories for his station. Recently he put together a keyer that is a superb example of craftsmanship. The unit works perfectly and yet it cost him only one third as much as the

(Continued on page 67)

(Continued from page 65)
factory made article after which it was fashioned.

WHAT ABOUT COMPACTNESS AND CONVENIENCE?—If you have the patience to design and redesign, and if you don't mind working in cramped quarters, you can come up with some pretty compact gadgets. In most instances, however, the average product of a home workshop is larger than its commercial counterpart. Although small size is often considered a virtue, under certain circumstances it is a drawback, especially when repairs become necessary. A lot fewer headaches are generated by rack and panel rigs with easily accessible components than by compact table toppers with their layer upon layer of parts squeezed into the smallest possible space.

CONCLUSION.—In spite of the great variety of kits and ready made equipment now on the market, and in spite of the convenience, compactness and excellent appearance of this gear, I believe that there is still a place in ham radio for the fellow who rolls his own.

If you want the best possible performance for each dollar expended—If you want a rig which boasts features not ordinarily included in manufactured gear—If you want a transmitter or receiver tailored to your own special requirements—If you want to increase your practical and theoretical knowledge of electronics, then try your hand at home construction.

I think you'll enjoy that wonderful feeling of accomplishment which comes only to those who operate equipment that they, themselves, have put together.

Phone Patching

OK between U.S. and Canada, Chile, Costa Rica, Cuba, Ecuador, Haiti, Honduras, Liberia, Mexico, Nicaragua, Panama, Paraguay, Peru and Venezuela. Puerto Rico and Virgin Islands count as part of U.S., as do U.S. licensed overseas stations using W- or K- prefixes (except KA2-KA9).

Incommunicado

Don't talk with the following: Cambodia FI8, XU; Indonesia PK, YB-YH; Laos XW8; and Viet Nam FI8, XV, 3W.

Who . . When .

It's fun to tell a QSO-pal: "don't you remember our first QSO on February 7th eight years ago, but friend, I haven't received your QSL yet. . . ." Well, we still 'remember' his name, his QTH, and maybe we can tell him some more details of that QSO, too. And the chap is amazed at our memory.

Well, here's the real truth: The contact really was eight years ago, but by my honor we didn't dig out the details from the final stage between our narrow shoulders. No, the info was picked up from the file system.

If you have no file system yet, here's one which certainly is interesting enough to get acquainted with. I do not aim to present this as the best and only one, but I have done well with it for some years.

Originally I printed a card quite different from this one. It had space for the call, name and QTH plus date/QSL for the first QSO on each band plus space for the date of every QSO. This was alright as long as I was operating only CW on the bands. However, the XYL got her ticket and wanted fone, so I had to change the cards. It became essential to reserve space for more details. Finally the present card was made to meet the requirements of any active amateur using any mode of transmission, CW, AM or SSB.

There are two sides printed of the cards. The cards are filed alphabetically according to the calls, and naturally the side with the call sign is kept in sight. So, here we go: Look at the Fig. 1. The 'box' in the upper

John, Helsinki — OH2YV

Bnd	SSB		PHONE		CW	
3,5						
7					1/1/51	x
14	11/9/59	x	12/8/57	x	8/9/58	x
21						
28	11/1/59	x			7/6/60	

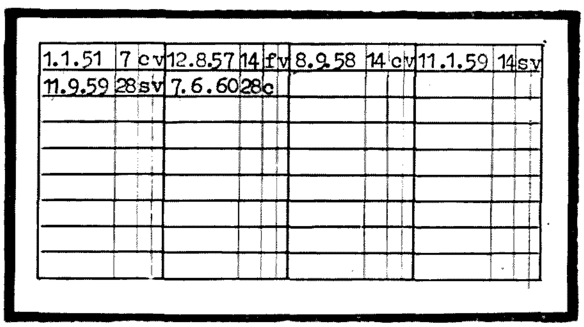
right corner is reserved for the call sign of the station worked, the long space left from the call-box is for the name and QTH. That's enough to tell the chap: "gld cuagn." For simplicity I have taken my own call as an example. If you find the card in your file it means that you have contacted me before. If you don't, just take an empty card and fill it. So we QSO'd, and you see: OH2YV name is John and QTH Helsinki. Look still at the picture No. 1. You see we have con-

Where . . and How

John Velamo, OH2YV

tacted at least the following: CW on three bands (7, 14 and 28 mc), AM on one band (14 mc) and two-way SSB on two bands (28 and 14 mc). Good, and still you find out that you have received my QSL for all other QSOs except that on 28 mc CW.—i.e. on this side of the card you enter the first QSO on each band and in each emission type. The small 'box' is reserved for an "x" or a "y" or whatever you like to use, when the QSL for that very QSO has been received. So now you understand the system.

Turn the card over (Fig. 2). There is



space for 36 contacts. Here I write the details of *every* QSO, including even those on the title side. Here is space for date, band, emission type, and QSL received. For the emission types I am using following abbreviations: C = CW, F = AM Phone, S = 2-way SSB. Someone may think the 'QSL box' useless, but as an active "award hunter" I have found it essential because many certificates require the QSO to be made after certain date. Here you can check both the date and QSL. Use just any mark, myself I have used "v" when QSL is o.k.—As said there is space for 36 QSO's on this card. Actually there are not very many cases where I have got to take another card after the first one has been filled up to the 36. However, due to the limited space in my drawer I *had* to print these little cards (size only about 3" x 5".) If you have more space for the file print larger cards.

There is some spare space on both sides of the card for possible extra notes (club station operator names, power, etc).

Well, there it is. Now you know my "damned good memory." Anyway, you may be sure that the next time we meet I will not need to pick up your card to remember your name; good pals remember the names of each other without any files. Just for safety sake let me look at that card, however, hi.

Thanks for the interest! Hope you got an idea from this.

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Ad Spec	71
Alden	57
Algeradio	39
Allied Radio	73
Alltronics-Howard	49
Amber Industrial	71
Arrow Electronics, Inc.	41
Barker & Williamson	47
Barry Electronics	69
Callbook	65
Call-D-Cal	40
Candee	65
Central Electronics	8
Clark	55
Clegg	1
Columbia	67
Cushcraft	63
Dale's	45
Drake	7
EICO	5
Evans Radio	43
Excello	70
Finney	35
Gidgets & Gadgets	51
Globe Industries	53
Gonset	Cover II
Graham	55
Hi-Par	71
House of Antennas	68
International Crystal	2
Jeff-tronics	45
KTV Towers	6
Lafayette Radio	37
Lektron	63
L-R Electronics	55
LW Electronics	53
McElroy	65
National	Cover IV
Neil	47
Petersen	Cover III
P & H	51
Radio Amateur Callbook	65
R-W Electronics	68
RTTA	70
Shorecrest	49
Spera	66
Stellar	49
Subscriptions to 73	55
Tapetone	63
Telrex	45
Texas Crystals	59
US #1 Electronics	71
VHF-UHF Associates	67
Western Radio (Nebraska)	67
Western Radio (San Diego)	49

(CW-RTTY from page 21)
rotary distributor contact and a single peaked cam which actuates an operating lever that advances the tape head one character for each shaft revolution. Two approaches to the problem bear promise. The simplest and the cheapest would be to replace the existing, single throw cam with a unit shaped to actuate the operating lever two or more times per revolution of the main shaft. The second approach, which is not easily accomplished or readily restorable, would be to increase the main shaft speed by the installation of special gears. The maximum operating speed of the tape head has not been determined, although the writer has heard reports of a 240 WPM modification applied to similar equipment.

In summary, the system as presented is workable and will meet a number of amateur requirements. The cost of the modification is negligible and the original utility of the equipment is not impaired. Further, the way is open for those with the inclination, equipment and time to increase the operating speed of the system. . . . Pafenberg

Tune Up With a Solar Battery

THE human eye is probably the most sensitive homegrown transducer known, yet it does not differentiate readily between small changes in light intensities, especially at high light levels.

When tuning a rig with a lamp for a dummy load, it is difficult to tell, by eye, when the resonant point has been reached. The lamp appears as bright a few degrees either side of resonance as it does at resonance.

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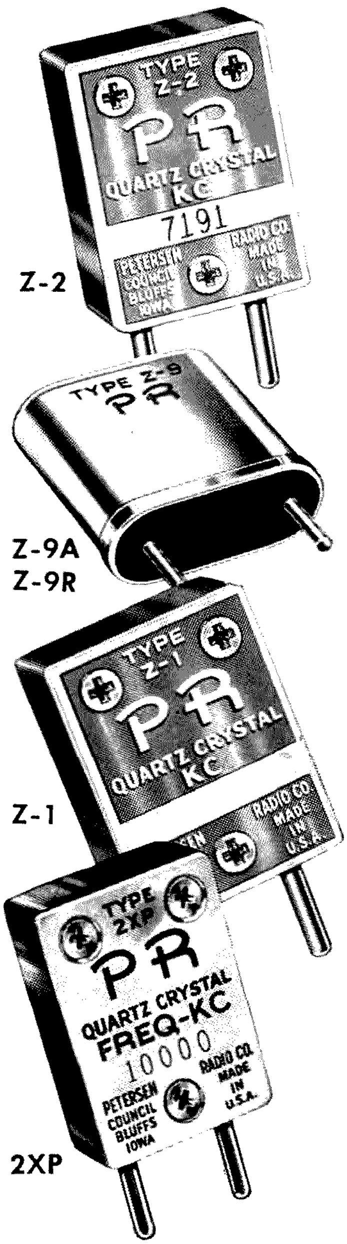

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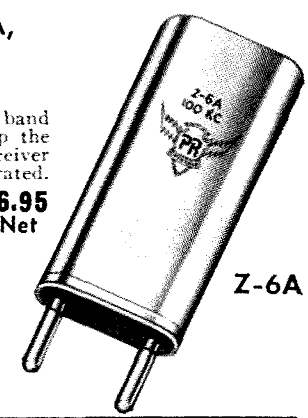

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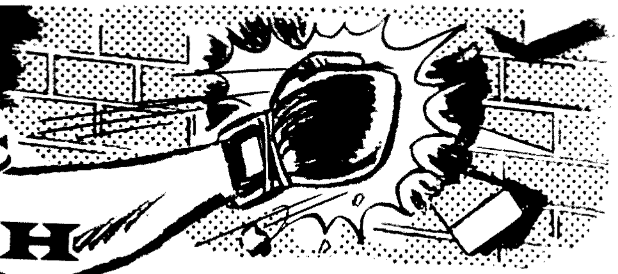

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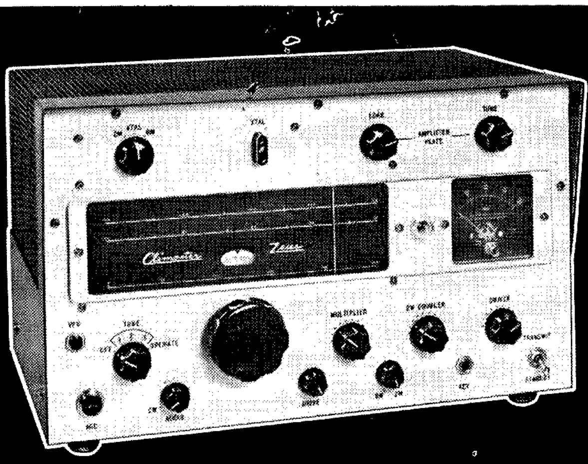

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Table of Contents

April 1961
Vol. 1, No. 7

Six Meter Nuvistor Converter .... Russell Summerville K8BYN 9
Two 6CW4's in cascode give a fearfully low noise figure.

Power Meter .... Tom Lamb K8ERV 12
Another valuable piece of test gear for the ham shack.

Surge Protection in Reverse .... Roy E. Pafenberg 13
Protect your silicon diode power supply from descruction by shorting.

Let's Modulate, Not Crepitate .... Richard Genaille K4ZGM 14
Getting good modulation out of a Heising Modulator.

A New Noise Limiter .... Jim Kyle K5JKX/6 16
Get out the soldering iron, this one'll go in your receiver.

Calibration .... Conway Wilson W4WQT 18
Why we haven't got it, how much we need it, and how to get it.

Big Cannon .... Jack Holloway W6VVZ 20
OK, here's a 20M KW amplifier, now stop bothering us for that.

Tennessee Indians .... Gray Berry K2SJN 25
The public relations side of taming those Indians.

Half Wave Feedlines .... Bill Roberts W9HOV 27
One resonant feedline for several bands? Yup.

Automation .... Jim Kyle K5JKX/6 28
You didn't think we'd pass up April without one feature, did you?

Audio Boosting the Command Receivers .... Art Korn K8HDR 30
Turns out to be rediculously simple . . . once you know how.

Pick Up the Droop .... Howard Pyle W7OE 31
Your beam been saggy lately?

40 Watt Transistor Modulator .... Monroe McDonald KL7DLC 32
Great for mobile rigs.

Testing the Heath Twoer .... Don Smith W3UZN 34
You will no doubt be flabbergasted to find that Don likes the Twoer.

R-F Noise Suppression .... Bill Ashby K2TKN 38
Technical treatise on how to exorcise the noise demons from your car.

432 mc Transistorized Converter .... J. Specialny W3HIX 40
Part II (ahem), the schematic diagram.

Take Your Pick .... Staff 42
Big technical article: IF selectivity and the devious means used to gain it.

Propagation Charts for April .... Dave Brown K2IGY 54
What time, when, to where on what bands . . . probably.

Writinq for 73 .... Staff 56
How to get rich beyond your wildest dreams.

Misc.:

Table of Contents 3
Editorial 4
New Use for a Crystal Socket 24
Ohmmeter Polarity Check 27
Toroid Tip 33
Bandel Linn K8LAP Cartoon 50
Three Dee World and U.S. Maps 51
Letters 52
Club Subscription Rates 52
AF MARS Technical Broadcasts 59
Other Ham Publications 63

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. . . de W2NSD

(never say die)

The more observant readers will discover that we have thrown budgetary caution to the winds this month and have bound in a postcard. The reasons behind this are manyfold and would possibly be too numerous to mention were it not that I have little else to comment on.

Besides goading more of you to vote on the articles you find most interesting, the card also will enable the more industrious to request literature from our advertisers just by writing in their name and addresses. Having already experienced the drawbacks of merely including a reader's service coupon in a magazine and being aware that the advertisers know how easy it is to circle a few extra numbers on incoming coupons to make the response look good, we plunged ahead with a more foolproof system.

Let me put in just a short congratulatory statement. You fellows have been doing a fine job and are holding up your end quite well as readers. The advertisers, who are paying for this magazine, are enthusiastic about your response and I note that many of them, after trying you out for a month or so, have decided to sign for a full year of advertising. Don't let down.

Building

We are getting more and more letters from readers who claim that 73 has pushed them over the brink and started them to home brewing. Operating is fun, but it is only *half* of the hobby. We have a long way to go yet. We'll keep at it with everything we can muster to develope this atrophied activity. Those of you who have been around the hobby for a few years can remember when the local distributor had a big parts department with tables of specials. You may even remember when parts manufacturers advertised in ham magazines. How many of you have seen a Bud catalog? I used to practically wear that one out looking over their coils, racks & panels, and small parts. Maybe, if we keep at it, we can see a return to the old days. Maybe we'll again be able to pour over catalogs of parts by National, Hammarlund, Johnson, Par-Metal, and Millen.

Propaganda

.. There are still a lot of fellows who don't know that 73 exists. We cannot, as you should be able to figure out, advertise in the other ham journals. This means that we're depending quite a lot on your to tell others about 73. If every reader mentioned 73 to every contact on the air for a few weeks, every ham in the country would at least *hear* about the magazine.

Grumbles

Someone wrote in complaining because he found some small errors in the magazine. He wanted to know why we didn't hire a better proof reader. The three examples he used to prove that 73 is a "mass" of errors consisted of two words with transposed letters and our "Subscription Department" ad which he thought was mispelled.

We will have to hire our first proof reader before we can attempt to hire a better one. Virginia and the authors do the best they can to correct the sometimes incredible mish-mash that comes back from the printer. I look 'em over too. What in the devil is it that bothers some folks so much about an occasional word getting bolixed up . . . it isn't as though this gave them even a slight difficulty in figuring out what is being written. The next thing you know we'll be getting requests for correct grammar usage. Good grief!

While these odd chaps are going over the magazine with a fine tooth comb looking for errors we are trying desperately just to make sure that we get all of each article in each issue. It is awfully easy to leave out a parts list, a coil table, or a photograph during the last hectic hours of hassle when we are trying to get everything set for the presses. Just how easy I found out last month when we managed to leave out the whole schematic diagram for the 432 mc converter. How many of you frustrated proof-readers noticed that one? Ha! Well, it's in this issue anyway, marked "part II."

How come no proof readers? Because we are trying to bring you a new type of ham magazine and we started from scratch without much scratch. Proof-reading volunteers will be accepted at our editorial offices at any time, the only thing is that they will have to work for the same salary as the rest of the staff.

Caveat Emptor

In spite of our acknowledged poverty we are, I believe, the most particular when it comes to our advertisers. Again, we have to depend on

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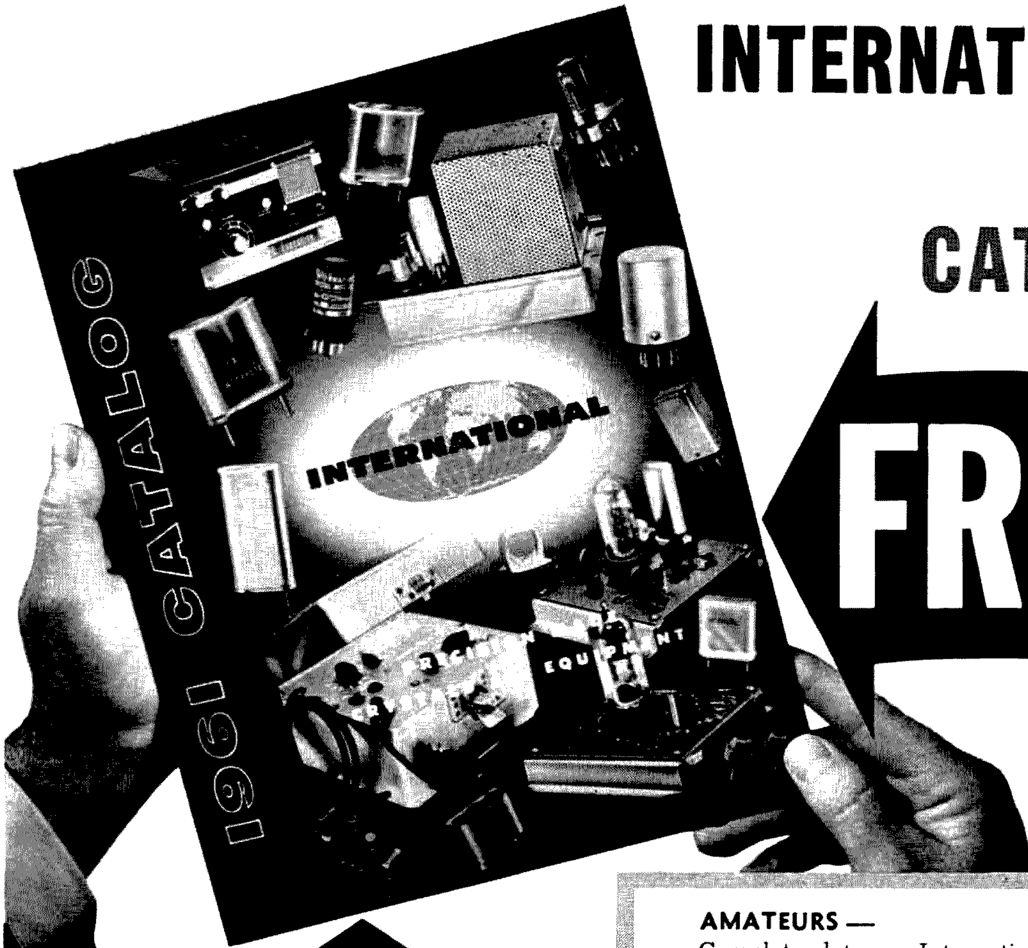

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you. Please let us know if you have any problems, but don't ask us to mediate or straighten them out. If we get several complaints we will just have to look elsewhere for an advertiser.

Feedback

We've enough votes on the January lineup of articles to conclusively determine the winner. Way out in front with 229 votes we find Tom Lamb's Nuvistor Converters. Our monthly technical article placed second with 147 votes. In third place with 115 votes is Down With Drift by Jim Kyle. 1296 mc by Bill Ashby was fourth with 96 votes. Four other articles received over 50 votes. I'm learning a lot from the votes. Some articles that I figure are of lesser interest turn out to get a lot of votes. For instance take the "8 mc Crystal Modification Kit" article by W3UZN in January. I figured that Heath and a handful of readers would be interested. Believe it or not we got 43 votes for this article! How many people could be interested in 1296 mc? 96 votes is quite a landslide.

The February issue vote puts Kyle right back up on top again. His "Rolling Your Own" really rolled up a score! All of which would seem to prove that interest *is* high in building. The VHF's get a lot of votes, so perhaps it isn't too surprising to have this 50 mc rig pull down the first prize: an all expenses paid trip to Santa Susana, California . . . plus 50% extra on the article payment. Second place goes to another VHF rig, the Two Meter Pip-Squeak by Ray Fulton K6BP. Ray is just recovering from an accident which stove in a few ribs and he may be behind on answering mail. Our big technical article on BFO's came in third! There just isn't any question, we've got to run more good technical articles. Kyle's Worlds Simplest Phone Patch was fourth, with Squawk by Ken Cole, W7IDF fifth. Both of our commercial gear evaluations got many votes from other than the manufacturers so we'll continue that sort of thing.

Conventions

We'll be seeing those of you who attend the Swampscott, Dayton, Rochester and Phoenix Conventions. Don't forget that Phoenix date on May 26-29th. It isn't much of a drive from Southern California, so I hope all you fellows come on over for the fun.

Virginia will be there with me and would like to meet you all.

California Style

U. S. #1 Electronics will officially open their store in Linden New Jersey on April First. I'll be over there picking things over as soon as they open up for they tell me that they have a veritable mountain of surplus stuff there.

. . . W2NSD

Russell M. Summerville K8BYN
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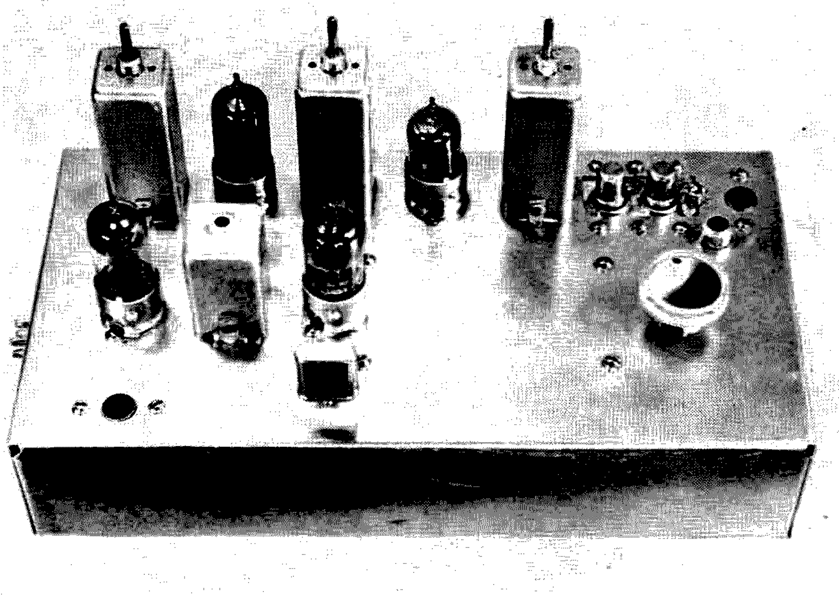


Fig. 2

Six Meter Nuvistor Cascode Converter

FOR many years it has been the secret desire of almost every amateur interested in the VHF bands to own one of those gold plated 417A converters, but for most of us scraping up the gold dollars to buy the tubes has been out of the question.

Now a miracle has happened! RCA has developed a tiny ceramic tube which they call a Nuvistor for use in their TV tuners. These little gems at a cost of only $2.49 each are the answer to your dreams. For all practical "ham" purposes they perform about the equal of the 417A!

After listening to a commercial on TV all about how noise free RCA's Nuvistor tuner was I decided just for kicks to build up a 6 meter converter using Nuvistors in cascode. The resulting converter outperformed most conventional converters and equaled a couple 417A converters in comparative noise tests.

Construction

To mount the Nuvistors cut out a piece of tin (tin solders real nice) 1½ inch by 1¾ inches and drill 2 holes just the size of the Nuvistor sockets. Also drill 6 holes around the edge of the tin plate. These are for mounting screws to fasten the tin plate solidly to the aluminum chassis. (See Fig. 2.) Mount the tin plate to the chassis. Bend back the 2 tabs on the Nuvistor sockets and slip them into the top of the holes cut for them. Solder the tabs to the tin plate. Be careful not to bend the lugs on the socket that are for the purpose of grounding the Nuvistor shield when it is inserted into the socket.

Two 8 terminal tie lug strips are mounted 2¼ inches apart and resistors "A" thru "H" are connected across the points. All of the resitors on the strip near the outside of chassis are connected together and this is the B plus bus line. (Fig. 3.)

Although it is not necessary to use them, for convenience and to save space dual capacitors were used on each tube socket and at the terminals of the *if* transformers. *Keep all leads short*—mount the capacitors as close to the socket pins as possible. If you use duals, just ground the center lead and connect the outer leads to the points to be bypassed.

It is customary to use rf chokes in series with filaments and to bypass them with small capacitors. By using shielded wire (the type with heavy wire and high internal capacity) for filament wiring the use of rf chokes and bypass capacitors is not necessary. Be sure to ground the shield close to each socket.

A neutralizing coil is usually employed where we use resistor "L". This coil to be useful must be resonated at 50 mc and unless

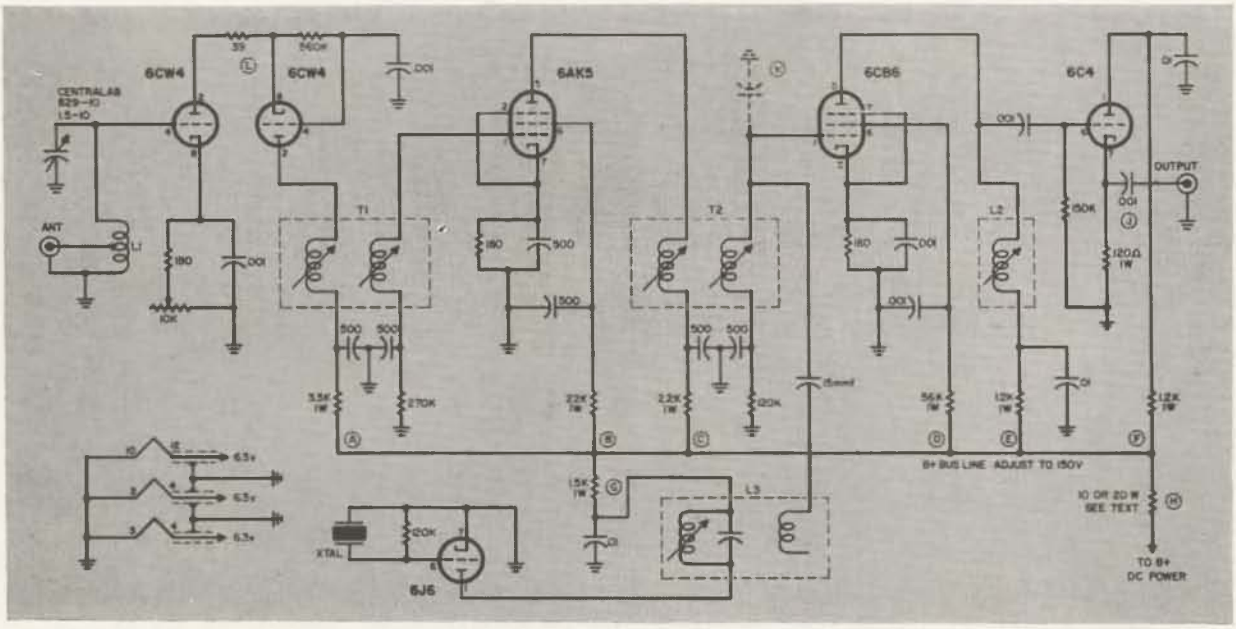


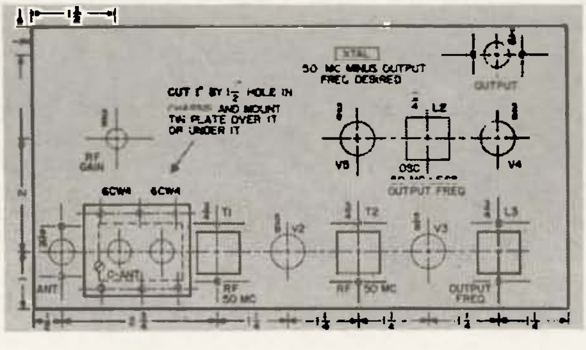
Fig. 1

it is correct it does little good. The increase in noise because of the use of the resistor in place of the usual coil is negligible.

I-F Transformers

The *if* transformers can be made from 40 mc video *if's* removed from an old TV set, or if you want to use new parts use Miller #6218-TV video *if* transformers. Remove all of the existing windings and wind 17 turns of #18 enamel wire to form the lower part of the transformer and connect to lugs. Then wind 10½ turns of the same wire to form the top half of the transformer and bring leads down to the lugs and solder.

In all tuned circuits in which a wide band pass is necessary it is possible to broaden out the response either by putting a "swamping" resistor across the tuned circuit or to make use of a circuit having a large L/C ratio. The latter method is used in this converter in both the *if* transformers and the input and output coils. The idea is to have the coils "self resonant" so that they resonate at the signal frequency with little or no capacity other than distributed capacity, stray circuit capacity, and tube capacity. Sometimes a small amount of capacity is necessary because it is impossible



to make all units exactly alike. If you find in final alignment that with the slugs all the way in the coils will not reach a peak then add a small capacitor from ground to plate or grid depending on which coil needs lowering—or both if necessary. (See "K" in Fig. 1.)

Several makes of slug coils were wound as described and all were found to resonate fairly close to 50 mc when connected into the circuit. If extra capacity is needed use as little as possible usually between 5 and 20 mmfd.

Coils

The input coil L1 is made of 10½ turns of #22 bare wire wound around a ⅜ inch coil form tapped at 2 turns for the antenna input. An *Airdux* type of coil could be used. The important thing is to be sure that with the antenna plugged into the jack, the tube in the socket and the circuit wired, the circuit will resonate at 50 mc when the tuning capacitor across the coil is tuned. If the frequency is too high add another turn or two to the coil if necessary and, if too low, take off a turn or two.

The frequency of the crystal and the oscillator tank circuit (L3) must be 50 mc less the output frequency desired from the converter. For example the SX101A has a 6 meter dial and requires an input of 30.5 mc. The oscillator frequency then must be 50 minus 30.5 or 19.5 mc. You can use a fundamental or overtone 19.5 mc crystal or a cheap surplus lower frequency crystal and multiply in the second half of the 6J6 to the desired frequency. The fundamental or overtone crystals are much to be preferred and will prevent any possibility of images, birdies, etc. You may prefer some other type of oscillator circuit. By much experimenting we found this simple circuit

would work wth more crystals than other more complicated circuits.

The output coil (L2) must be broad and so it is tuned to resonance by it's own distributed capacity. With the bottom slug of the coil all the way in and the top slug part way in, put enough turns of wire around the form so that it will resonate at the desired output frequency. This will have to be done experimentally and checked with a grid dipper while the coil is wired into the circuit. The converter shown here had an output frequency of 30.5 megacycles and it was found that with 25 turns of #22 enameled wire that frequency was obtained. If you want to use a low output frequency, such as 5 megacycles, it would be desirable to use a finer wire.

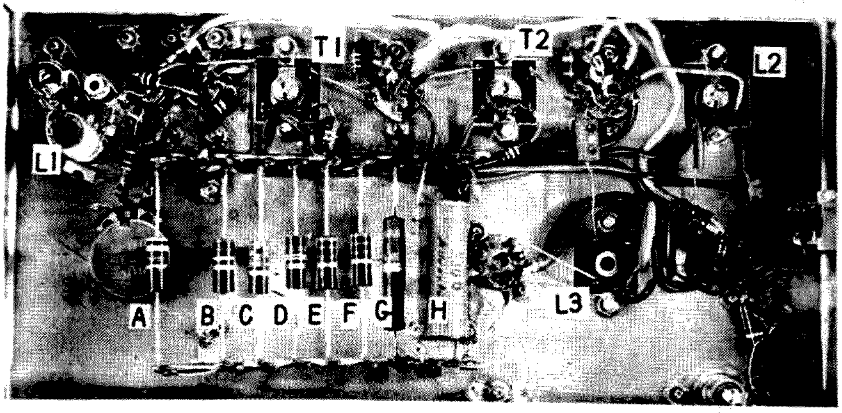


Fig. 3

The oscillator coil (L3) is a tank circuit and should be a fairly high Q so some capacity should be across the coil. It was found that with a 25 mmfd capacitor across the coil it would tune to 19.5 mc when wound with 15 turns of #18 wire. To pick up a signal for injection into the mixer a couple turns of insulated wire is wrapped loosely around the coil and soldered to the lug which connects to the mixer grid through the 15 mmfd capacitor. The coil form (slug tuned) was removed from an old TV tuner, but a Miller 6218TV video *if* transformer would work here also, as would many other types of coils.

Power Requirements

The converter will draw about 35 ma when the voltage on the B plus bus has 150 volts on it. Resistor "H" is a voltage dropping resistor in series with all of the decoupling and dropping resistors feeding the tubes. If your power source is 250 volts you will need a drop across "H" of 100 volts. Since $R = \frac{E}{I}$ we find we need $\frac{100}{.035}$ or approx. 2860 ohms. A 3000 ohm resistor would work fine. The power dissipation needed would be 100 X .035 or 3.5 watts. A 10 watt resistor would be OK but a 20 watt one still better since by using a much larger one there would be less heat dissipated. If your supply is 150 Volts connect directly to B plus bus line.

Alignment

From a WEAK signal source such as a weak station or signal generator or crystal oscillator adjust the rf gain control on your receiver so that the S meter will read about S 5. Set signal source to around 50.3 mc and adjust C across antenna input coil for peak. Set Signal source to 50.8 and tune the top of T1 and T2 for maximum reading on S meter. If meter goes above S 9 reduce rf gain control. Then set signal source to 50.1 and adjust the bottom of T1 and T2 for peak reading. Now set to 50.5 and adjust output coil L2 for Maximum. If you cannot get a peak with slugs all the way into the coil add some capacity as described earlier. You should get very broad peaks—don't expect a sharp one. The sharpness of the peaks in no way indicates the noise figure of the converter. In fact we found with the input coil way off frequency we could still get a good noise figure with much reduced sensitivity.

Conclusion

This converter is hot—it puts out more than an S9 "hiss" into most receivers. If your receiver does not have an rf gain control it would probably be well to reduce the output of the converter feeding the receiver by putting a very small capacitor "J" in place of the .001 shown in the diagram. The front of the converter is quite subject to overload from strong stations and because of it's great sensi-

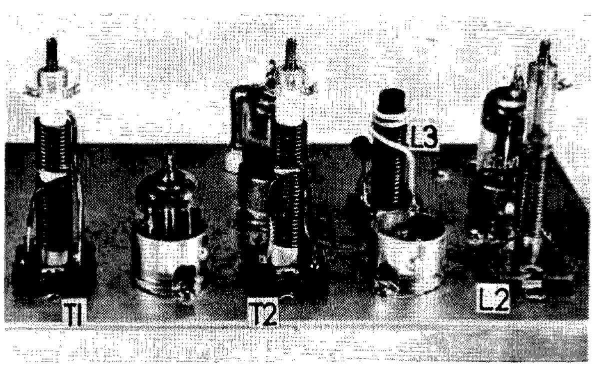


Fig. 4

(Continued on page 61)

The Power Meter

Tom Lamb K8ERV
1066 Larchwood Road
Mansfield, Ohio

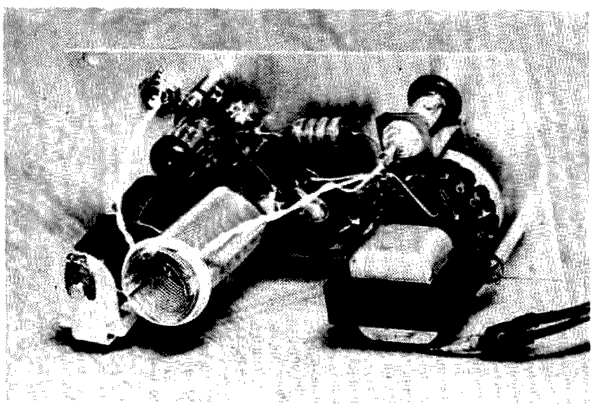
THE Power Meter was designed to be a "dummy next stage." When coupled to an oscillator, amplifier or multiplier tank coil it will indicate the approximate drive available for the following stage. It is basically a continuous tuning, link coupled absorbtion wavemeter with a loaded and metered *rf* indicator.

The Circuit

The first departure from standard wavemeter design is the use of a multiband resonant circuit, tuning 4 to 35 mc. The very simple MBT described by Johnson[1] solves the problem of winding and finding numerous plug in coils. The reader should refer to Johnson's article for changes in the tuning range or L and C values. As with any multiband tank, two frequencies are tuned simultaneously. However, these two frequencies are far enough apart that the correct one will usually be obvious from the circuit under test.

The MBT is coupled into the simulated "next stage" consisting of various values of grid resistance, a grid current meter, and a 6AL5 diode. Don't try to use a semiconductor diode in this circuit.

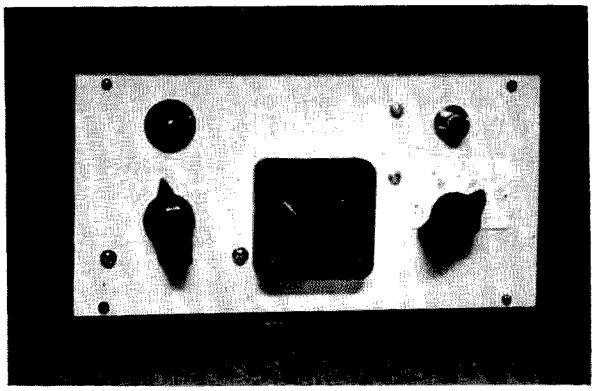
A #49 pilot lamp is coupled to the MBT for those who are used to its power indication. The lamp should be removed from its socket during calibration, accurate frequency reading and



metered power reading.

The construction is not at all critical. This meter was thrown together in a hurry to meet an immediate need. Mount L1 to C1 with short leads, don't place metal panels too near to L1, and you have it made.

[1]Johnson, "Multiband Tuning Circuits," QST, July, 1954.



Remove the lamp and set S1 to 10K-1 ma. Loosely couple the link to a grid dip oscillator. Set each desired calibration frequency on the GDO, peak C1 and mark the dial. When the high end of C1 is reached, pick up the same frequency at the low end and keep on going up.

The Power Meter will do anything a conventional wavemeter will do, within its frequency range. Some of its uses are:

Frequency Indication-Method 1. Couple the Power Meter link to an operating circuit, peak the meter with C1, and read the frequency. S1 serves as a sensitivity control. Note that the dial will indicate two possible frequencies. normally the correct one will be obvious, but there is no way of being sure without additional equipment. This is the disadvantage of the mulitband tank.

Frequency Indication-Method 2. If the tuned circuit to be measured has its own indicator, such as a grid or plate current meter, simply use the Power Meter as an *absorbtion* wavemeter. Couple the link to the operating tuned circuit and adjust C1 for a sharp dip in the circuit's indicator. The advantage of Method 2. is that no line power is required for the 6AL5, making the Power Meter useful for portable and mobile work.

Harmonic Indicator. Couple the link to the circuit being tested and run C1 throughout its range. Use S1 for a sensitivity control. All frequencies present will be read and their relative voltages indicated.*

It is interesting to note the amount of undesired output in high-order frequency multi-

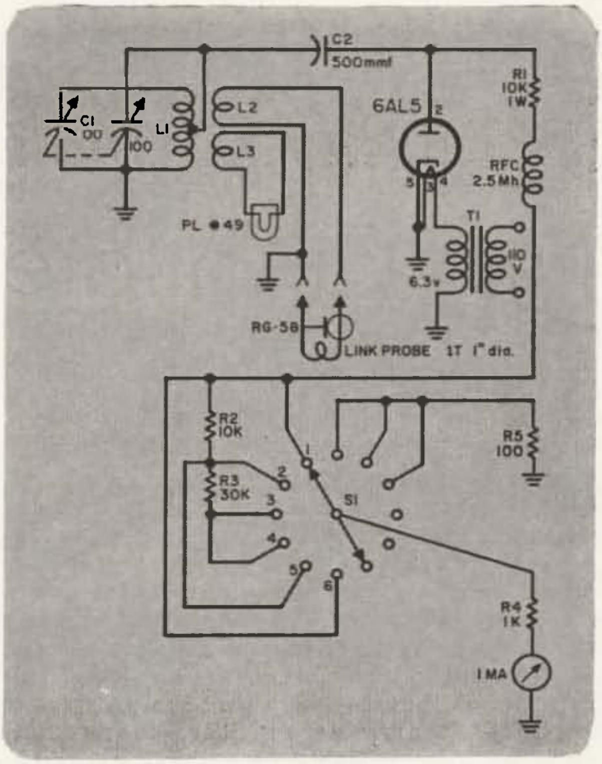
**Note that the meter indication may not be exactly the same at various frequencies even with the same input power. This is because the various couplings and the L/C ratios change with frequency.*

pliers. The low Q tank circuit usually used in multipliers may pass considerable energy at one multiplication above and below the desired one. Thus in a quadrupler the Power Meter will show additional outputs at three and five times the fundamental. If strong enough, these outputs can contribute to the grid current of the next stage and give a falsely high reading.

In the hetrodyne type of exciter, the output strength of the undesired products of mixing is strongly affected by the amplitude of the input signal. Indicating the relative voltages of the desired and undesired outputs is a main feature of the Power Meter.

Output Power Indicator. When breadboarding an oscillator or multiplier, the Power Meter becomes a metered load, or dummy next stage. Set Sl for the planned resistance and current of the next stage, couple the Power Meter to the output coil, and read the approximate drive that will be obtained.

With a little experience, the Power Meter can be one of the most useful accessories in the shack. It is in almost daily use in mine, and I would like to hear from anyone finding other useful applications. 73



Surge Protection in Reverse

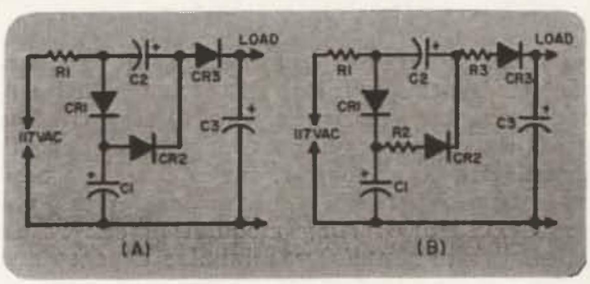
Roy E. Pafenberg

A VOLTAGE multiplier power supplies have increased in popularity since the introduction of silicon diodes. The classic voltage tripler circuit is familiar to most and the function of the input surge resistor needs little explanation. The value of this resistor, R1 in Fig. 1A, is such as to limit the charging current of the capacitors to a value below the maximum surge current rating of the rectifiers. For example, the Sarkes Tarzian M-500 silicon diode is rated at 30 amperes surge current. The limiting resistor is calculated on the basis of peak applied voltage and for a line operated supply would be $\frac{117 \times 1.414}{30}$ or at least 5.5 ohms.

Not so obvious is the function of resistors R2 and R3 in Figure 1B. Assume the power supply shown in Fig. 1A is delivering power to a light load and that the input line is opened, leaving C1 charged to the peak line voltage. Accidental or safety shorting of the supply output will discharge C1 through diodes CR2 and CR3, invariably leading to the catastrophic failure of both rectifier units. Resistors R2 and R3 will limit this current to a safe value in the event the power supply output is accidentally shorted. Values the same as R1 should provide adequate protection with commonly used filter capacitor values.

The entire question of safety shorting of capacitors is open to debate. Capacitors, even of the electrolytic type, can hold lethal charges for a substantial period of time and common sense dictates that they should be discharged before working on the circuit. On the other hand, short circuiting the terminals of a charged capacitor can result in current that will fuse the internal leads of the unit. Also, rigging of haywire limiting resistors to safely discharge the capacitors could possibly result in more accidents that the procedure was designed to avoid.

The best answer appears to be the inclusion of limiting resistors such as R2 and R3 in Fig. 1 B to provide protection to the components in the event of accidental shorting of the supply and a fail safe bleeder circuit for personnel protection. This arrangement will provide the maximum protection to components and the amateur. . . . Pafenberg



Let's Modulate, Not Crepitate

Richard A. Genaill K4ZGM
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Winston-Salem, N. C.

EVERY year, about this time, a rash of articles begin to appear in almost all of the popular "ham" publications dealing with low-power transmitters designed for mobile or other portable type operations. This rash is more than likely caused by visions of vacation trips, Field Day activities or possibly the end of the winter hibernation. At any rate, this article is designed to help *you*, the prospective low-power transmitter builder, to modulate that flea powered job without having to make any excuses for low modulation percentage or severe distortion.

You may have noticed that many of the portable transmitters described in various articles make use of "choke-coupled" or, more commonly, Heising modulation. In many cases, the author fails to indicate that in his transmitter design he may have only 70 to 80 per-cent modulation with low distortion or 100 per-cent modulation with severe distortion. The usual circuit arrangements for "choke-coupled" modulation do not permit one to achieve a happy medium between the two extremes. The proper use of Heising modulation can result in maximum simplicity, minimize expense and give one a fully modulated-low distortion portable transmitter that will get results. Here's how it's done, the easy way.

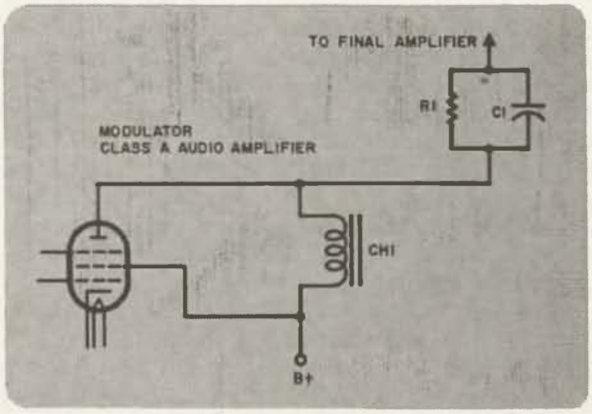


Fig. 1. Choke coupled or Heising modulator. C1—Audio by-pass capacitor. CH1—Audio choke (high impedance at audio frequencies). R1—Dropping resistor (adjusted for 100% modulation by consulting tube charts).

To understand the basic fundamentals of "choke-coupled" modulation take a look at Fig. 1. This is the circuit of the basic Heising modulator and simplicity in itself. The input power to the final amplifier is a combination of the dc power from the plate supply and the audio power from the Class A Audio Amplifier-Modulator. The use of audio choke CH1, rather than a modulation transformer, establishes a 1-to-1 coupling ratio between the modulator tube and the final amplifier stage requiring that the dc plate voltage and plate current to the final amplifier be adjusted to a value which will produce a suitable impedance match between the final amplifier and the Class A Amplifier plate. Even though we may be able to select suitable modulator and final amplifier tubes whose electrical characteristics will provide an impedance match we would not be able to achieve 100 per-cent modulation without severe distortion unless resistor R1 and capacitor C1 were included in the circuit. This is because, with identical plate voltage on both the final amplifier and modulator, the audio frequency voltage developed by the modulator cannot swing to the 100 per-cent modulation level (Zero to twice the plate voltage) without causing distortion as it approaches zero. R1 provides the necessary voltage drop between the modulator and the final amplifier to make possible a sufficient audio frequency voltage swing to permit 100 per-cent modulation with lower distortion. The capacitor C1 provides the necessary audio by-pass across resistor R1. The reactance of C1 should not be more than one-tenth the resistance of R1 at 100 cycles. The value of R1 must be calculated by using the published family of curves for the modulator tube use. Without R1 and C1, the modulation percentage is limited to between 70 and 80 per-cent to minimize distortion in the case of the average transmitter. It can be seen, by these few facts, that the design of the circuit entails a certain amount of calculation in order that satisfactory opera-

tion may be obtained.

The circuit of Fig. 2 shows a system of shunt feed that virtually eliminates the need for extensive calculations. One can usually dig up an extra choke in the "J" box, especially the small, low current capacity receiver type. It can be seen that a difference in voltage can be obtained for the modulator and final amplifier either by the use of the dropping resistor R1 or by the use of two separate plate supplies. For the sake of economy the use of the dropping resistor is to be preferred. With a means of obtaining two different voltages, the plate voltage for the modulator tube may be kept higher than the voltage on the final amplifier thus permitting the necessary audio frequency voltage swing at a lower distortion level. The usual simple rf amplifier plate impedance calculations should be made and the amount of audio required for 100 per-cent modulation should be determined. Since the arrangement provides a 1-to-1 coupling ratio, the tube selected for the modulator should be capable of delivering the necessary amount of audio power (usually one-half of the rf amplifier input dc power) at the same plate impedance as the final amplifier. So that the af voltage on the plate of the modulator may swing sufficiently to produce 100 per-cent modulation without the swing reaching zero, the tube used in the modulator should be one which requires a somewhat higher operating plate voltage than the final amplifier. The audio chokes in Fig. 2 may be regular filter chokes of the 10 to 30 henry variety. The inductive reactance of choke CH2 should be at least equal to the Class C amplifier load impedance at the lowest frequency to be modulated. Capacitor C1 should be of the oil type and have a reactance much lower than the Class C rf amplifier load impedance at the lowest audio frequency to be transmitted. In most cases anything from .5 to 2 mfd. will do the trick.

To make things a lot simpler when you start laying out that low power rig, Fig. 3 provides

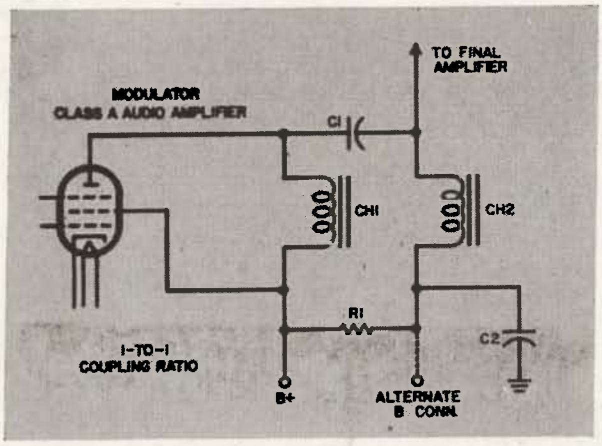


Fig. 2. Choke coupled or Heising modulator using shunt feed. C1—Coupling capacitor (oil). CH1 & CH2—Audio chokes (filter 10 to 30 Hy). R1—Dropping resistor (adj. for correct final amplifier plate voltage . . . see text). C2—Filter capacitor (use only if R1 is used.)

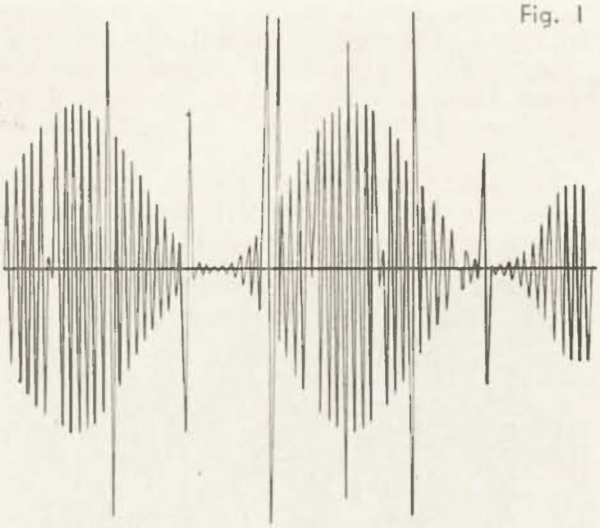
a listing of the most popular tubes which can be used for Class A Amplifier service at low power outputs. Many of the portable rigs and most of the Citizen Band units make use of a final amplifier tube which runs at approximately 250 volts at 20 ma for an input of 5 watts. The plate input impedance runs approximately 12,000 ohms. Approximately 2.5 watts of audio are required. A 6AG7 would do a splendid job in modulating in this case. The 300 volts on the plate would permit sufficient af voltage swing without distortion, the audio power is more than adequate, the plate impedance is close enough to function properly and the 300 volts can be dropped to 250 for the final amplifier tube with no great difficulty. Another combination might be a 6L6 final amplifier running at 325 volts and 70 ma for an input of about 22 watts. The plate impedance would be around 4,600 ohms and the required audio power for 100 per-cent modulation would be near 11 watts. Another 6L6 with 350 volts on the plate would do the job quite well as the modulator.

The shunt-feed system has been used by the author in several low powered transmitters and has proven to be quite successful. It is always a pleasure to have other hams tell you that your low power rig is the best sounding one that they have heard on the air and that you have the audio punch that most low power rigs lack. The next time you start laying out that simple modulator for that portable or mobile unit give shunt-fed Heising a try. You'll be glad that you did. . . . K4ZGM

Type	Plate Volts	Load Resistance Ohms	Power Output Watts
6AG7	300	10,000	3.0
6AK6	180	10,000	1.1
6AQ5	180	5,500	2.0
6AQ5	250	5,000	4.5
6AR5	250	7,600	3.4
6AR5	250	7,000	3.2
6AS5	150	4,500	2.2
6BK5	250	6,500	3.5
6CL6	250	7,500	2.8
6F6	285	7,000	4.8
6F6	250	7,000	3.2
6G6G	180	10,000	1.1
6G6G	180	12,000	0.25
6K6GT	315	9,000	4.5
6K6GT	250	7,600	3.4
6K6GT	100	12,000	0.35
6L6	350	4,200	10.8
6L6	250	2,500	6.5
6V6	315	8,500	5.5
6V6	250	5,000	4.5
6V6	180	5,500	2.00

Fig. 3. Typical Tube Types Useful in Class A Amplifier—Low Power Modulator Service

Fig. 1



A New Noise-Limiter Circuit

Jim Kyle, K5JKX/6

THE automatic-noise-limiter circuitry is today one of the weakest design links in a good communications receiver. While modern ANL circuits do remove some types of impulse noise, they still leave an appreciable amount in the signal, and it's a rare new-product report that fails to condemn the ANL with faint praise.

Most of today's receivers still use gating-diode noise limiters, which either short the noise pulses to ground when a certain level is exceeded, or open the audio signal path for the duration of the pulse. In neither case is anything done about noise pulses which do not reach limiting level.

In fact, most communications-receiver users habitually set the limiting level to operate at the 50-percent-modulation point, thereby severely distorting the audio signal, in an effort to minimize noise leakage.

The reason for lagging development of noise-limiter circuitry in this country may be that the only groups seriously interested in the problem are hams and citizens-band operators, and neither group is large enough nor vocal enough to demand improvement.

However, our British cousins have been forced to deal with the problem, since TV sound in Great Britain is carried on an AM channel instead of the FM used here. At the frequencies used, impulse noise has been a serious situation for them—and the video audience *is* large enough and vocal enough to demand improvements.

As a result, at least one British writer has declared that (under the proper conditions) AM sound may even be superior in signal-to-noise ratio and in general quality to FM.

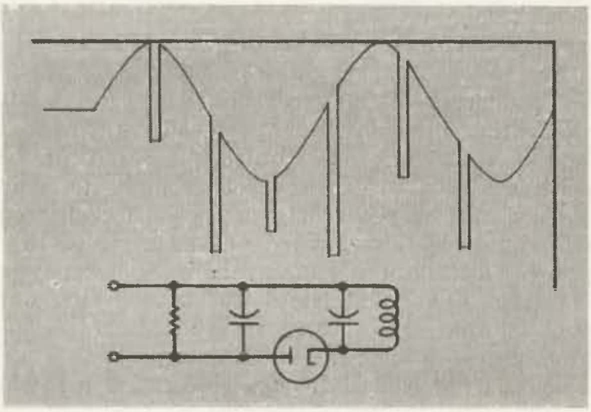
Be that as it may, they have developed some excellent noise limiters. The one shown here was described in the November, 1960, issue of *Electronic Technology* (Television Noise Limiting in AM Sound Channels, by H. D. Kitchin) and is capable of virtually wiping out all ordinary impulse noise from a communications receiver. The circuit as shown has been converted to use standard American tubes and part values.

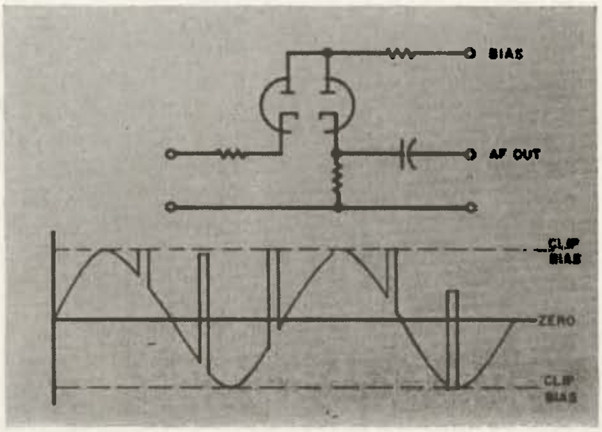
This limiter, though it appears similar to our conventional series-diode gate at first glance, operates on a completely different principle. Rather than rejecting noise pulses because of their amplitude, it rejects them because of their rapid rise time. This enables it to detect even the smallest noise pulses and to wipe them from the audio signal.

To get an idea of how it works, look first at Figure 1. This shows (to accurate scale) a 3000-cycle sine wave modulated on a 100-kc carrier wave, and badly distorted by noise pulses of approximately 10-microsecond duration (most troublesome noise pulses last from 1 to 10 microseconds, so this is the worst usual case). Note that the noise may either add to the signal, or cancel it out. This signal exists at the detector input.

Figure 2 shows the same signal as it would be seen at the detector load resistor. Note that the only noise pulses which survive the detection process are those which momentarily increase signal strength.

Figure 3 illustrates the action of the con-





ventional full-wave series-diode noise limiter, used in most modern communications receivers, when the limiting level is set to clip at 100 percent modulation. While the high noise peaks are eliminated, fairly large "stumps" remain and are frequently clearly audible.

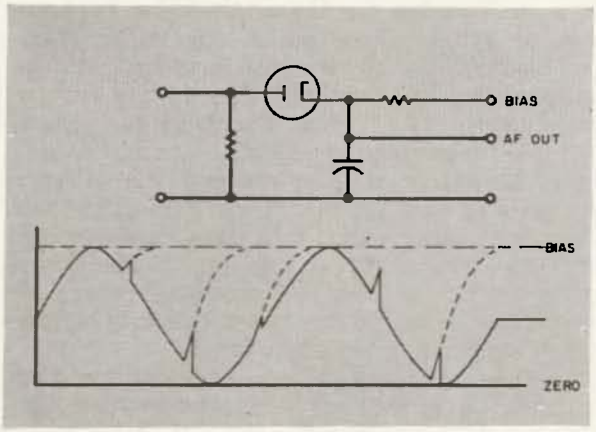


Figure 4 shows the rate-of-change limiter. Incoming audio, containing noise pulses, is applied to the diode plate. Negative bias equal to the peak-to-peak signal voltage is applied to the cathode. The time constant of the bias resistor and the output capacitor, together with the bias voltage, determine the operating point.

When the time constant is properly chosen, the voltage across the capacitor follows the audio signal envelope which passes through the diode, and the output is a replica of the input.

However, when a noise pulse causes a rapid change of the input signal value, the diode is suddenly driven into reverse-bias conditions and cuts off. The capacitor voltage then rises toward the bias value at a rate determined by the time constant (dotted lines in Figure 4). As soon as the input signal returns to a value low enough to reestablish forward-bias conditions, the capacitor discharges to the audio-signal level and output once more follows input.

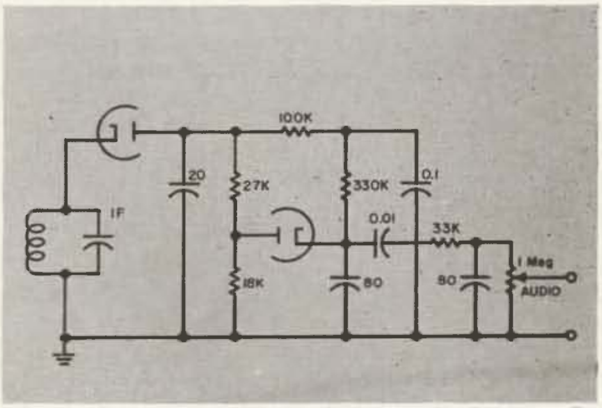
The noise pulse is limited to an extremely small value by this process, if bias voltage is approximately equal to peak-to-peak signal input. However, if fixed bias is used this will rarely be the case, since signal voltage varies from instant to instant.

By taking the bias voltage from the detector load resistor (through a filter) and obtaining the audio-signal input from a tap on this resistor, instantaneous bias voltage can be set at the proper value for minimum noise and zero distortion. A comparison of noise-pulse suppression achieved by this limiter and by the series diode is shown in Table I.

The circuit can easily be added to any receiver now equipped with a diode detector. The schematic diagram is shown in Figure 5. The complete limiter circuit can be assembled on a Vector 7-pin turret and substituted for the existing detector.

Three critical points must be checked during construction. The volume control's total resistance must be 1 megohm, as shown. Any different resistance will vary the load on the limiter, requiring a change in limiter time constant (determined by the 330K resistor and the 80 mmfd capacitor from cathode to ground). Connections to the last if transformer must be as shown; the existing diode load resistor and filter must be disconnected. Frequently, these components are located inside the if transformer case. If in doubt, contact the manufacturer or check service information. Finally, note that all signal-carrying lines are at high impedance to ground and are therefore subject to hum pickup from heater leads. Twist the heater leads together and keep them away from all components.

As shown, the limiter will handle 100-percent-modulated signals without distortion, and will suppress most noise pulses more than 40 db below the signal level. If you should want to suppress the noise more than this, at a sacrifice in distortion, you can change the ratio of the 18K and 27K resistors which make up the detector load resistance. Total value of the two, however, should be maintained between 45K and 50K ohms for proper detector action. Increasing the 18K unit while



decreasing the 27K resistor will lower the effective bias level, thereby suppressing the noise even more. . . . K5JKX/6

Pulse Suppression Below Signal Level

Pulse Width (in microsec)	Series-Diode	Modified Rate-of-Change
1	48 db	85-90 db
5	30 db	55 db
10	24 db	43 db
50	10 db	15 db
100	6 db	6 db
300	0 db	0 db
above 300	not effective	not effective

NOTES: These values assume audio cutoff frequency of 3 kc following limiter; higher cutoff frequency will degrade absolute values but will not alter ratio between limiters.

Most noise pulses range from 1 to 10 micro seconds in length.

Suppression of 40 db or more effectively eliminates the pulse for most listeners.

WHAT IS CALIBRATION?

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WE Hams are a lucky group. We all have the National Bureau of Standards right in our Hamshacks. We tune in WWV and use it to calibrate a "built-in" transfer standard crystal oscillator in our receivers. We transfer this calibration right down or up to the band we intend to operate on. We set a dial indicator or slightly change the VFO (local oscillator) frequency and operate all evening on our pet Ham band within a few cycles of the frequency shown on the receiver and transmittter dial. To prove our abilities as calibration experts it is not uncommon for us to argue with each other over our operating frequency—why to miss it by 50 cycles is often a complete disgrace. 50 parts in several million is good and we know it. Yes, we Hams are a lucky group but . . . alas, the next morning we go to work and forget our sense of accuracy completely. On the job we are an omphaloskepsis (you had better look that one up).

It is the purpose of this short article to get just a few of you, at least one in every factory, one in every part of industry, to go to work for better calibration on the job. Just ask yourself if someone on your job is being as exact with calibration as you are when you set your receiver frequency. Calibration is important no matter what you do for a living. If you make shoe laces, work at a service station, a meat market—yes, even dig ditches you or someone makes measurements of one sort or another. If you cannot trace that measurement back through a series of calibrations to the National Bureau of Standards you don't have calibration. Somewhere up the line there is an omphaloskepsis that needs to be awakened.

Let me outline a typical case. Let us follow a typical Ham through a not too typical day. Let's call him Joe Ham and heaven bless the real life Joe Hams who may read this. Old Joe wakes up at 6 AM, plus or minus a minute or two. His alarm clock is always off a little but the local broadcast station blares out the time several times as he tries to shave and catch the morning news at the same time. Incidently, he hasn't noticed that his XYL had to set the little radio to 890 kc to get the station on 900 kc—so the little $24.95 ac-dc set is off a little, what do you expect, Collins dials? Joe tries to turn the shower completely off but knows it will still leak a little. He has never stopped to think that he may never get a good gasket for the water valve because there is little calibration at the gasket factory and all their little washers are just a shade small. Joe finally dashes to the car to head for work and notes the gas gage shows ¼ full—Jr. must have used the car again last night. He dares not try to make it all the way to the job because that gas gage has never been quite right. The great mystery of America—who calibrate gas gages? Joe stops by the service station and buys 10 gallons of gas plus or minus a few pints (usually minus a few) and finally gets to work.

Joe has to make a measurement or two today, he is a part of a test laboratory. He is going to test a little gadget that his company sells to a big Government Prime contractor. He has to look at a waveform or two on a scope and make a few dc voltage measurements. Ask Joe about the calibration of his equipment and he will tell you right quick. "Old boy, look on this meter, it has a calibration sticker on it—why it is due for calibration tomorrow, one of the boys from the standards lab should be around sometime today to get it and supply him with another that is calibrated." The sticker shows that the meter was, indeed, calibrated last summer sometime. Sure enough the calibration expert shows up and takes his meter for calibration. No one has ever calibrated his scope because after all it is the latest model "Technetroonix" and the book says it is accurate to 3%. Old Joe has never stopped to wonder if the book meant it would always be 3% until something went wrong with it or if the book meant that it should also be calibrated periodically.

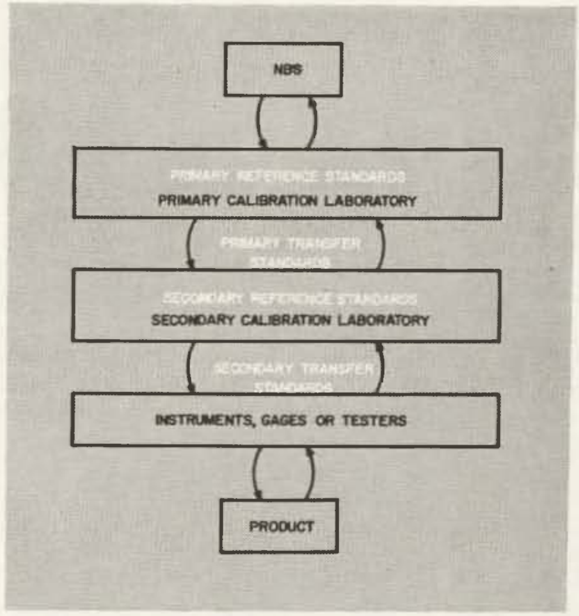
Old Joe Ham decides to ask a few questions about calibration. When the expert comes for his meter he quite casually asks him. "What do you check my meter against when you calibrate it?" He is told, "Why anyone should know that, it is carefully calibrated against a 0.25% Standard meter, a real expensive job. Boy, you are lucky we have such good calibration in our factory . . . and besides, we do this for you every 6 months." Joe decides to press the subject. "Hey," he says, "how about that Standard meter? Where is it calibrated?" The meter expert looks down his nose and says, "Are you kidding old boy, that's a Standard meter, the manufacturer rates it a 0.25% full scale and it doesn't need any calibration. Who do you think we are, the National Bureau of Standards?" And so it goes. Joe Ham is happy so is the meter expert. Joe thinks he has good calibration and the expert goes back to the lab and brags to the boys how he got that jerk Joe Ham all

squared away about calibration.

Actually, of course, it is not this bad at most of the factories. I have, however, seen some that are much worse. Figure 1 depicts a good calibration path to the National Bureau of Standards. It is a series of closed calibration loops, each a link in the path to NBS. Just as with any other chain, it is only as strong as its weakest link. Can you trace every measurement you make along a chain of this type? If not, your job may not be turning out a good product. The wonderful thing about the situation is that it only takes one good wide awake Joe Ham to make a vast improvement in the accuracy of the measurements being done on your job. Just how important measurements are can be shown by a typical example. Did you ever stop to think about the measurement to an accuracy of a millionth of an inch? Measurements of this type are often made in the missile industry.

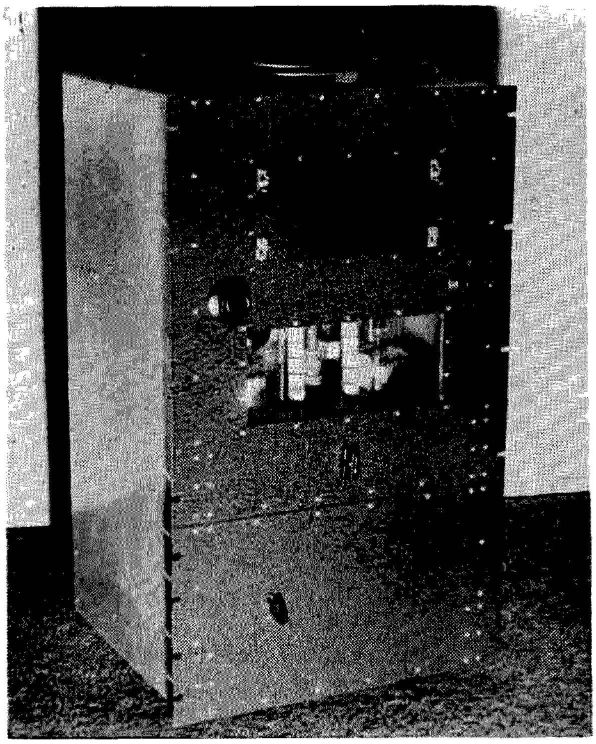
Pluck out one of the hairs from your head (or from the xyls if you have no hair). Now that little hair is about three thousands of an inch thick. If, somehow, you could split it 3000 times, into 3000 little slices you would have a millionth of an inch. Same thing as comparing the width of a dime to a stack of dimes twice as high as the Empire State building. Now if you missed the measurement of certain bore sights in the missile business by just that much, that missile would miss the moon by 1000 miles. Yes, calibration is extremely important and our nation is sadly lagging. The NBS is always faced with a backlog and can't find the necessary time to develop new standards and measures.

A lot of companies lack adequate lab or plant facilities and controls to house a calibration program. Many keep inadequate calibration records with resulting loss of control over calibration intervals. Some, as in Joe Hams case, don't even know when their local standards had last been recalibrated. The important thing for Joe Ham to remember is that rf and microwave measurements is on the problem list. Specific areas in need include: average and peak values of pulsed microwave power, attenuation, voltage standing-wave ratio, unmodulated microwave power. Power and attenuation measurements across the whole rf spectrum actually lag the state of the art. Precision measurement of a-c voltage and capacitance is another big trouble area. We can't shoot for the moon with a flintlock rifle. Improvements in measurements capabilities will ultimately be reflected in savings of many millions of dollars for our nation. Joe Ham can, perhaps, help more than any other segment of our nation. Go out to your job with a solid determination to really find out if all measurements show traceability to NBS. Even if you think you know, prove it to yourself. If there is a missing link, a broken link in the chain—do something about it. See that stand-



ards and calibration are considered at the design and engineering phases, as well as the quality control and test phases of production.

The Army is doing something about calibration in the Army missile business. The Atomic weapons business is, perhaps, leading the nation with their alert calibration program. These are two areas that I can speak for because I have been up to my neck in their programs but how about all the countless thousands of other major industries in our nation. We know that the Russians couldn't have produced the A-Bomb even with a ship load of our secret blueprints unless they had extreme competence in the art of measurements based upon a broad foundation of scientific education and research. Are they concerned with the science of measurements. You bet they are. Their Council of Ministers headed up by Khrushchev himself has a special Committee on Standards, Measurement and Measurement Apparatus. There are five research institutes devoted to improving new techniques of measurement and maintaining precise standards. These institutes supervise the work of a large network of calibration centers, about 129 of them. The new Seven Year Plan to the twenty-first Congress of the Communist Party calls for more than doubling these efforts by 1965. Now, Joe Ham, this is some pretty stiff competition. We have about 1600 scientists and engineers, assisted by a similar number of technicians, skilled artisans and mechanics within the U. S. Dept. of Commerce, called the National Bureau of Standards, trying to offer this competition. They need Joe Hams help. If you will just take the same care as you do in getting on frequency out to your job the results will surprise you. If you know a better way to measure something, tell someone about it. Become a "calibration crank" on your job —your help is needed. . . . W4WQT



The Big Cannon

Jack Holloway W6VVZ
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Van Nuys, California

Not long ago, several locals were holding a postmortem following a DX phone contest, when one of the gang insisted that we should build a BIG CANNON on 20 meters for future contests. With maximum power, we could challenge the antenna farm and mountain top locations for difficult to get European multipliers, without having to move to an antenna farm ourselves. Twenty meters, continued our friend, allows the best reliable long haul communications most of the time. As a result, it is the most competitive band with the most QRM, as every ham realizes. Therefore, power is the only practical means by which we can hope to crack the QRM and thereby increase our number of European contacts.

Some of the gang went along with the power idea, and decided to build a new big final-final. At first, though, it appeared as if we would need far more money for the project than was available to us. But we slowly came to realize that day dreaming about vacuum variables, 1000 watt plate dissipation tetrodes, and silver plated band switching inductors is a luxuriously fascinating pastime, which does not get any final amplifier on the air. We also came to the conclusion that a DX station cannot determine if the incoming signal eminates from silvered inductors or just plain copper. If the signal is clean, it doesn't matter one decibel to the other end of the line, nor should it to you. Therefore, we decided that it is not necessary nor mandatory to spend a great sum of money to build an *effective* high powered amplifier; so we designed a KW amplifier which could be built at a reasonable cost. In order to achieve the reasonable cost stipulation, we scanned the surplus market seeking components for our version of a 20 meter BIG CANNON.

When we finally unveiled the CANNON, some of the locals expressed enough interest to cause us to believe that hams elsewhere might be interested too. Here it is.

Insofar as a choice of a tube is concerned, the once very popular 304TL still offers the most plate dissipation, and the most long term reliability due to its electrical and mechanical ruggedness, of any tube on the market for the price. Watts per dollar it cannot be beat. That fact still holds true. Its 300 watt plate dissipation can withstand a terrific beating, and so can the filament due to its tremendous reserve emission. It has the advantage, too, of not requiring special consideration for easy to destroy grids, as in a tetrode. However, since we worked unsuccessfully with the 304TL on numerous previous occasions, we were hesitant to try it again; particularly in a single-ended final. Time and again we built single ended 304TL finals, only to have it operate erratically due to uncontrollable parasitics, and never did there seem to be enough available drive power. Always, too, was the ever present problem of attaining neutralizing that would hold from one band to another. So in the BIG CANNON we decided to try our luck with a truly balanced push-pull final. By going push-pull, we figured that physical and electrical symmetry would cancel out the stray inductive

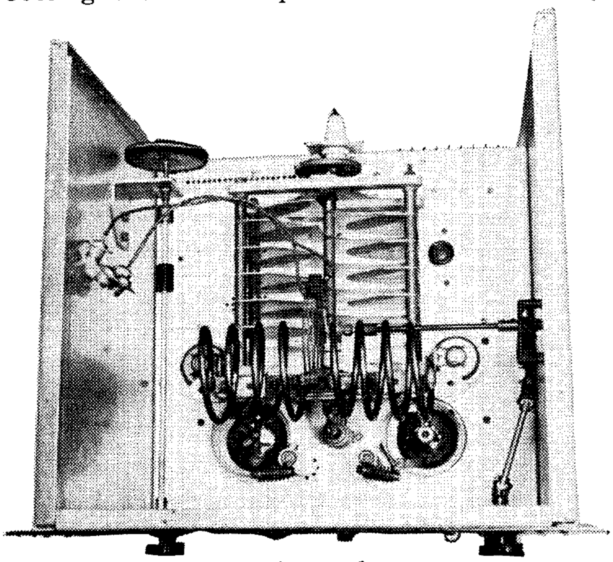
and capacitive effects that caused our previous single ended failures. Two 304TLs seem like an awful lot of wasted plate dissipation, but if one anticipates going SSB, a push-pull class AB_1 linear amplifier with sufficient power handling capability is an attractive idea, especially if this high powered capability can be had at minimum cost.

Another neutralization headache with the 304TL is the difficulty of obtaining neutralization capacitors of sufficient capacity and voltage breakdown, yet compact in physical size, that will perform without failure. We previously attempted to use every kind of known air gap capacitor with no success, but this time we tried ceramics, and they continue to work perfectly. We found just what we needed on the surplus market in some 7500 working volt, 50 mmfd ceramic doorknob capacitors. When six of these are screwed end to end in a pile, the total capacity is 8.3 mmfd which is within 0.3 mmfd required to neutralize the 304TL. We figure the 45,000 volt breakdown is more than adequate. It is possible of course to stack other combinations of ceramic capacitors to attain the required neutralization value. For example: three, 10,000 volt, 25 mmfd ceramic doorknobs would be a satisfactory substitute, and would be less expensive besides being mechanically more convenient. Insofar as obtaining sufficient drive power for the 304TL, we decided this time to build the driver as an integral part of the final, and to use an easy to drive tube that would have more than enough reserve plate dissipation. We found our tube, again on the surplus market, in the 4E27. A tube that can be driven to full output with one watt drive. Another reason for choosing this tube is that it can operate at the same plate potential as the final, thus eliminating the requirement for an additional power supply.

An approach toward solving the 304TL parasitic problem is made in the same manner, and with the same degree of caution, as is done with tetrodes. First, the 304TL grid cap and internal grid leads are mounted below the chassis deck to achieve isolation between grid and plate circuits. The internal grid collector ring is at chassis level at correct mounting depth. Second, the incoming and outgoing power leads are isolated to minimize external coupling between grid and plate circuits. Third, adequate shielding is used between grid and plate circuits. Last, the plate tank to ground impedance is lowered to a minimum value at parasitic frequencies by shunting each end of the plate tank circuit to ground with a surplus vacuum padding capacitor. These procedures serve another purpose, such as the annihilation of possible TV1, and the improvement of overall circuit efficiency.

Mechanically, the final and driver are housed in one RF tight housing that can be hung in an open frame rack. This eliminates the need for an expensive cabinet, and at the same time allows the unit to be placed on a table top if it should be decided to operate in that way. The two side panels, top, bottom, and rear shield piece for the driver are cut and folded from surplus aluminum stock. The driver panel and final panel are joined rf-tight by permanently securing a right angle strip of aluminum to the bottom edge of the final chassis so that the top back edge of the driver panel can be secured to the right angle strip with sheet metal screws.

In this final-driver unit, inexpensive wire screen mesh purchased from the hardware store is used for shielding the back side of the final compartment, whereas the back side of the driver compartment is closed in with aluminum sheet so the unit can be pressurized. A surplus blower from a Beachmaster amplifier is used for the forced air cooling. Note that holes are drilled into the final chassis deck directly over the 4E27, above the final amplifier grid leak resistor, and around the porcelain feedthrough bushings which support the stacks of ceramic neutralization condensers in the final. These holes allow air escape from the pressurized driver cabinet section and at the same time cool final amplifier components. Cooling the final amplifier is not a necessity



Top view—304TL final. Female coax connectors are hanging free from inside top of cabinet. Black knob on chassis top is grid drive balance control.

in any event, but it was speculated that cool air around the 4E27 might prolong tube life. If the unit is to be operated in a normally cool operating room, 4E27 cooling precautions are unnecessary.

Because we had decided to make it possible to change final tank coils from the front panel in order to facilitate rapid band change, a door is cut into the front panel as illustrated. Snap-clips which retain the door are taken from a surplus BC-375 tuning drawer, and the retaining rim for the door, which is bolted to the rear side of the front panel, is cut from a

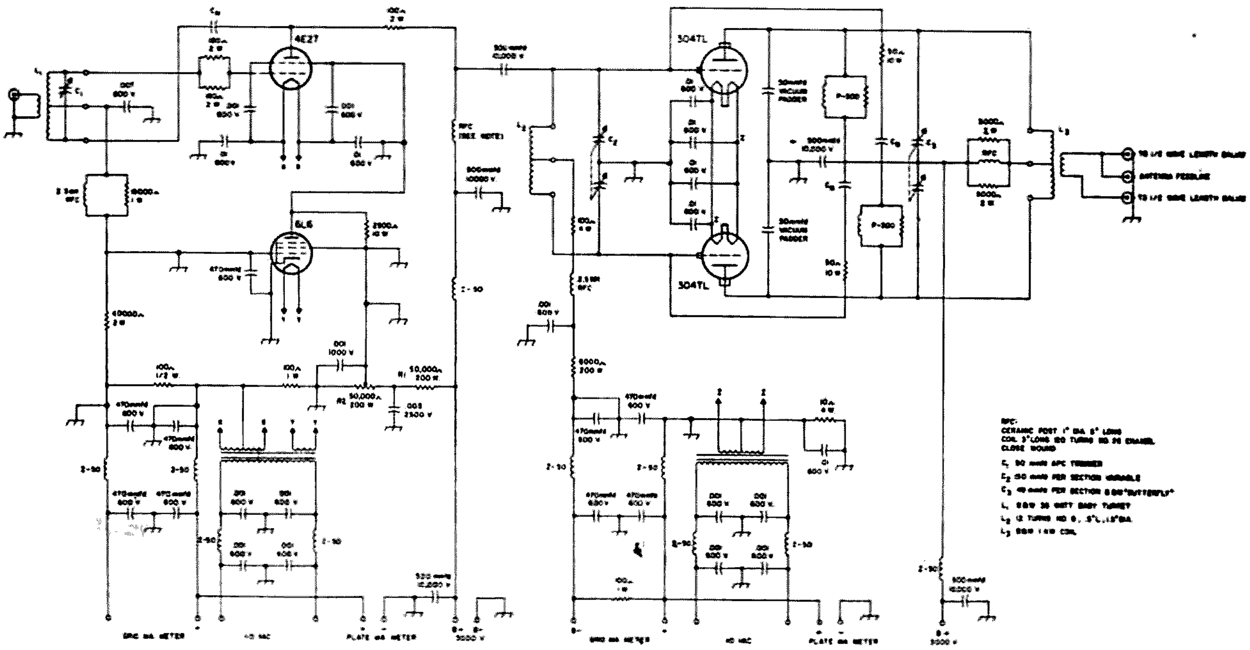
discarded panel. The right angle reduced gear drive assembly for controlling the final tank swinging link assembly is also taken from the same BC-375 surplus item.

Since the shaft for the final plate tank tuning capacitor would appear through the front panel window when conventionally mounted, an around the back fence tuning system was devised using a pair of broadcast receiver dial string drums. Despite a few raised eyebrows at this "antiquated" string drive technique, no failure has been experienced since we first accomplished a good tight stringing job. A BC drive wheel for the shaft end of the B & W butterfly tank condenser has a ⅜" diameter hole, and is sweated onto the brass shaft of the butterfly tank condenser. The 3/16" thick aluminum bracket supporting the bushing and drum wheel, mounted toward the rear of the left hand cabinet wall, is bent from an old panel. Also, note that the shafts used in both the final tank tuning and swinging link systems are of high grade insulating material. Metal could be used, but the less power consuming material near the final tank coil, the better.

Plate tank coils are modified from the original to insure the highest possible efficiency. This type of improvement was discovered once while working on a push-pull tetrode amplifier, and the measured increase in output power is well worth noting. Usually, plug in tank coils are constructed so that the high circulating current which flows within the parallel tank circuit is routed external to the coil right in the high current center point through two banana plugs and jacks. Here, the circuit is more often than not completed with some small bit of wire without regard for the losses caused by the high circulating current. The net result, of course, is loss of output power. In this final, however, a copper strap joins the two inside ends of the split winding coil. This is accomplished by removing the two center banana plugs, placing a ¾ inch wide strap of copper under the two center coil support straps, bolting the coil straps and the copper strap together through the steatite bar, and using one of the removed bannana plugs as a B+ connector to the center of the coil. The modified coil is illustrated in figure X. We are so satisfied with this more efficient coil arrangement that coils for all bands have been similarly modified.

The 4E27 driver tube is mounted so that its plate cap is located close to the final grid tank circuit. The perforated shield around two sides of the driver tube is mandatory. Without it, the stage is extremely difficult, if not impossible to tame down parasitic-wise, and neutralization is difficult to maintain. Although this was originally to be a 20 meter final exclusively, a B & W band switching turret assembly is used in the 4E27 grid circuit, and the right angle drive for front panel control is again taken from the BC-375 tuning drawer. The 4E27 grid turret assembly has a separate air trimmer placed in parallel with each individual grid coil. The grid circuit is so loaded by the two series input grid resistors, that once the trimmer condenser for each grid coil is adjusted to resonance in the center of each band, no further tuning adjustment is necessary when shifting frequency across any one of the phone bands.

Switching bands? Yep. When we ventured forth on this project, we kept in mind the idea of adapting this basic design for use in other finals that would be all band. For that matter, we wanted a design which could one day be switched over with a minimum of lost investment to a final that might use 4-250A's, or 4-400A's. Our foresight seems to have paid off,



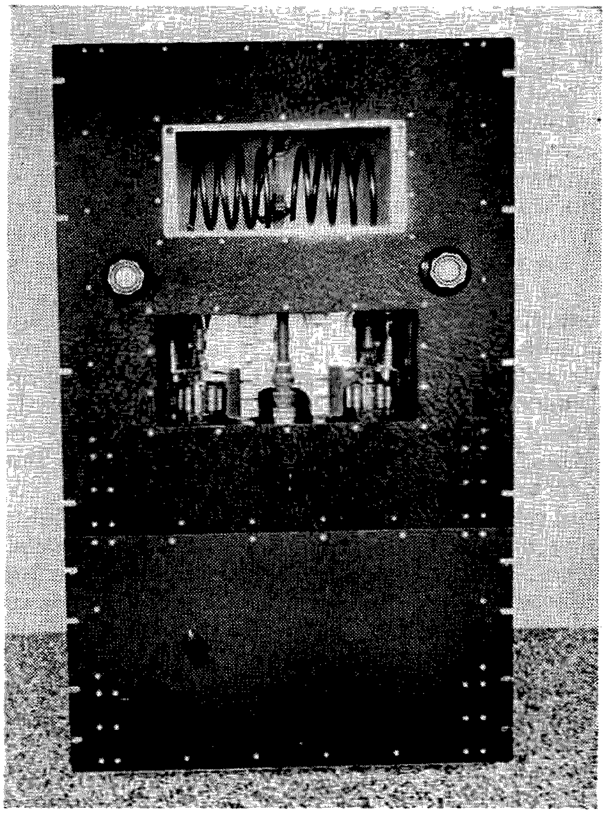
since two other finals have been built utilizing this identical approach. One of these other finals uses a pair of 304TL's, and is a truly all band rig with an MB-150 all band tuner for the grid circuit. In another version, the driver stage is eliminated and a pair of 4-250A's is used in layout identical to the 304TL rig, but with an MB40 all band tuner for its grid circuit.

The 4E27 driver in the 20 meter only BIG CANNON is neutralized for stability, but in the all band version of this rig, it was found to be unnecessary. Parasitic suppressors are required in both plate and grid leads of the 4E27 stage for absolute stability. The RFC in the 4E27 plate circuit is homemade and functions without resonant effects on all ham bands. Its specifications are given in the schematic.

Screen voltage for the 4E27 is supplied through dropping resistors R1 and R2 from the 3000 volt plate supply. The adjustable tap on R1 not only controls screen voltage, but also final amplifier grid drive power. Once the slider tap is set for adequate final grid current on 20 meters, it need not be adjusted further. Since this is primarily built as a class C AM rig, no fixed bias supplies are used. Consequently, in order to protect the 4E27, a 6L6 clamp tube is used with a 2500 ohm resistor between screen and plate to give improved clamp tube operation. The final is protected from loss of exitation by an overcurrent relay located in the HV power supply.

Grid and plate meters for both driver and final are mounted in a standard meter panel external to the driver-final unit. Therefore, as a safety precaution, 100 ohm resistors complete meter to ground circuits within the enclosed cabinet. These are needed in order to maintain completed circuits even if the cable interconnecting the meter panel and driver-final cabinet should be inadvertently disconnected. Without these resistors, for example, full plate voltage would appear between final filament transformer center tap and ground should the final amplifier plate current meter be accidently removed from the circuit.

Because the stack of ceramic capacitors does not supply quite enough capacitance to completely neutralize the final circuit, a slight additional amount is gained through the addition of alumnimum trim tabs. These tabs have a 6/32 inch hole drilled through them which allows the tab to be held in place between the ceramic feedthrough insulators and the bottom of the ceramic condenser neutralizing stack. The size of the tab is not critical, and may be cut to approximately 2 inches tall by 1½ inches wide. Fine neutralization adjustment may be had by slightly unscrewing the ceramic condenser stack from the ceramic feedthrough insulator screw, and changing the relationship of the flat side of the tab in relation to the 304TL plate.



Front view—304TL final. Coil access door is removed to show 20 meter coil in place. Controls, top to bottom, left to right: plate tank tuning, swinging link control, grid tank tuning, and unused grid bandswitch in the 4E27 driver.

Achieving equal grid drive to push-pull circuits is imperative in order to realize the full benefits this circuit has to offer. To attain balance, a 15 mmfd variable capacitor is connected between ground and the grid of the 304TL which is not capacitively coupled to the 4E27. This adjustable capacity allows the input capacity to the 304TL's to be balanced by offsetting the output capacity of the 4E27. In this manner, drive power to the final may be equalized. Approximate balance may be obtained by noting the color of the two final plate tubes, and adjusting the capacitor in small increments until their relative color appears to be equal. A more precise way would be to independently meter the cathode currents of each 304TL, and balance the tubes by obtaining equal plate and grid current readings.

The 50 mmfd vacuum padder condensers shunting each side of the final tank butterfly condenser to ground serve several purposes: One, they help keep high order harmonic frequencies bypassed to ground—thus helping eliminate possible TVI. Two, they serve to keep the plate tank circuit balanced in respect to ground. Three, they add enough capacity to the butterfly condenser so that it is possible to attain a loaded Q of about 20 on twenty meters. A Q of 20 is about optimum for ease of loading and for allowing some degree of harmonic reduction.

Note that two 4700 ohm, 2 watt resistors are added in parallel with the final plate tank RFC. The only RFC we had was an old National R-175; due to its poor design, and circut conditions, it was necessary to dampen out an erratic parasitic voltage that appeared and burned out the bottom segment of the windings. It is probable that this would not happen with the newer versions of the R-175.

Neutralization circuit parasitics always seem to be present in 304TL amplifiers, and in this one it is necessary to have both the 40 ohm non-inductive resistors and the Ohmite PC suppressors in order to completely clean up all tendencies for the final to take-off. In the 304TL all-band version of this final using the MB-150 grid circuit, only the PC suppressors are needed.

Testing of the driver and final for stability and lack of parasitics is accomplished as follows: Three, 200 watt, 1000 ohm resistors are placed in series between a 300 volt power supply and the driver and final (driver and final HV inputs wired together). The cabinet is of course, grounded, no rf input is applied to the driver stage, and no dummy load nor antenna is coupled to the final output link. Actual final plate dissipation under these conditions will be near 300 watts per tube. A sensitive instrument such as an oscilloscope, or an antennascope, is connected to the final output link as an indicator, and the final plate tank tuning and final grid tuning are carefully tuned through all possible tuning combinations. No output signals will be indicated when all is functioning correctly.

As this is conceived as primarily a 20 meter only final, we decided to add a ½ wave balun across the output link to improve loading and matching conditions between the 52 ohm coax line and final tank. The improvement in output power transfer is well worth the trouble, but for all-band operation, the technique is obviously too cumbersome. Length of the ½ wave, 52 ohm coax balun is 22'-9½".

This final has operated many continuous hours without component failure or breakdown. More important, even though operated on the shadow side of a hill away from TV stations, there has never been a recorded case of harmonically caused TVI. Washout cases have occurred, but these have been easily cured with a high-pass filter. Operation-wise, like the two subsequent copies referred to above, it is a dream. Loaded and tuned in the middle of the 20 meter band, no further adjustments are necessary when moving from one edge of the phone band to the other.

As further comment on the practical versatility of the finals' design, owners of commercially built 100 watt output exciters can use the 304TL amplifier without need for the 4E27 driver stage. The final can be driven to full legal input by 100 watt of exitation and high level modulated in class C, or operated as a class AB_1 linear amplifier with negligible required driving power.

For Linear SSB Operation

Link couple directly into the final grid tank. As is the case with my particular final, a separate link must be wound with insulated wire and inserted into the final grid tank. When an MB-150 grid tank circuit is used in the final, the problem of link coupling is simplified. Use regulated fixed bias on the 304TL's. Remove *all* power from the 4E27 driver stage. Operate the final in class AB-1, and it will drive with negligible drive-power required.

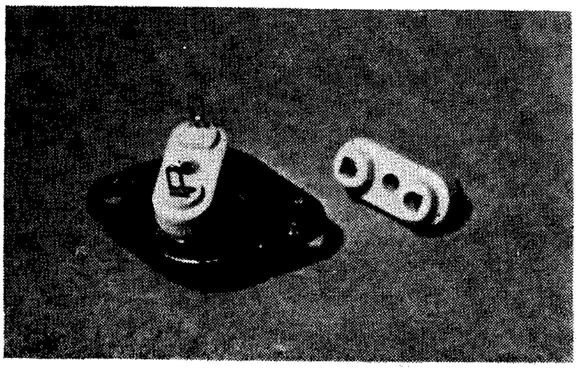
. . . W6VVZ

New Use for Crystal Socket

Roy E. Pafenberg

Despite several years popularity, power transistor sockets are still difficult to locate. The power transistor is not strictly a "plug-in" device since the mounting screws and insulators are required. However, socket connection to the base and emitter is a convenience and worth the cost of the socket.

Photo . . . Jim Gardner



A socket which is ideal for power transistors is widely available. This socket is designed to accept the small, hermetically sealed crystal units that have become so popular in Citizens Band and other equipment. These holders have a pin spacing of .487" and pin diameter of .05". This is in fairly close conformity with the transistor pin spacing of .43" and pin diameter of .04". The socket easily accommodates this small disparity and snug seating with good electrical contact is obtained.

The photograph shows a crystal holder socket installed on the transistor and a view of the socket. It will be noted that the unit is designed for under chassis mounting. The socket will flush mount in a 3/32" chassis, although its use is not limited to this thickness. Many manufacturers make these sockets and the Millen Type 33302 is typical of those available.

Eight Little – Nine Little Tennessee Indians

Gray Berry K2SJN
Communications Club of
New Rochelle, N. Y.

ONE of the hardest-working committees of The Communications Club of New Rochelle is, unfortunately, the TVI Committee. In a way, we've asked for it by carefully placing stories in the local press from time to time telling fellow-residents how and where to report Tennessee Valley Indians—not to mention their close tribal cousins, the hams that breaks into a hi-fi set, or is picked up on the telephone without benefit of hybrid patch. Which means that our committee has been able to compile a fairly fat file of case histories on interference.

There have been many articles, more than a few books, a section of the ARRL Handbook and so on all dealing with *mechanics* of interference suppression at the transmitter, or in the TV set. Most hams aren't on the air very long before they run into the need for this material. There is no intent in the present article to deal with such matters as low and high pass filters, shielding, stub antennas and so forth; what we think may be helpful is a list of some of the remarks that are thrown at our Committee by more or less (usually less with a capital "L"!) understanding neighbors—and possible ways to cope with them.

Probably the most common accusation is worded more or less like this:

"You're deliberately interfering with my ba'l game" This usually occurs in the last half of the ninth, score tied and the winning run on base—no matter what the hour.)

Assuming that the TV owner is willing to listen, we find an answer like this *may* calm the situation.

The ham says: "Mr. Madguy, look at it this way. We hams are on the air to try to reach other hams. They are listening on the parts of the radio bands where they expect to hear other hams. And that's where they are sending out their calls. So why would a ham go on the air on a frequency where no one can hear him or call him? Besides, if we go on any other frequency except those that the FCC assigns to us, we face loss of license, a fine and even a jail sentence."

So he asks "Then how come I hear you?"

And you have the chance to explain quietly and calmly (because he *may* be honestly interested in finding out!) all about signal rejection and so forth. But a word of warning—shun the "snow job" to show how much more you know than he does! He still doesn't like hearing your CQ over Mel Allen's mellifluous tones. Tell him what's and why's in words of one syllable. Lose his train of thought and you're on the way back to an angry neighbor.

So much for the first of our ten little indians.

"You're an amateur; my professional service man told me. . . . "

Now here is a real curve! Because the service man told the TV set owner that nothing could be done about interference (Don't laugh—plenty of them will do just that!) you are now on the spot doubly. In the mind of the set owner, you are at fault (naturally) and Mr. Paid-for-what-he's supposed-to-know has said nothing can be done about it. Of course, you know better, but how to tell the TV set owner without reflecting on his judgement?

We've found one helpful come-back to this one. "Mr. Madguy, the Olympics were just held in Rome (or the tennis matches at Forest Hills, the Golf Championships at the local country club or what have you.) Those competitors were all *amateurs* simply because they don't get paid for their skills and knowledge. As a matter of fact, amateurs developed TV in the first place. Amateurs made the first cross-ocean short wave contacts, first coast-to-coast short wave, etc., etc., ending up with "Moonbounce" and "Project Echo". The only reason we're called amateurs is because the Federal Government that gives us our licenses says we cannot be paid in any way for what we do. (Careful, now!) We have to pass an examination before we can go on the air; not very many service men take any test at all."

So now you know something after all, in the mind of your irate neighbor. Next step is to convince him something can be done about his TVI. By the time you've had even two complaints, you'll find one that has been cleaned up to the complete satisfaction of the set owner. It's a smart move to ask him if you can have any other set owner check as to the success. If you once have one or two pleased complaints, the rest is easy. Just refer your latest TV owner to one or two others in the neighborhood . . . and to the sets you *know* are clean next door, or in the same building. "See, there's proof of what I've been saying; something *can* be done."

Indian Number Three—*"Of course, it's your fault; I never had any interference before you put that thing on the air!"*

Ask him to think about it this way; suppose he has a hole in his roof. So long as the sun shines, he doesn't even know it's there. But let the rains come, and that self-same hole lets in the water. If it doesn't rain for months, the roof is still going to leak as soon as the rain does fall. And a TV set that will let interference creep in is just like that roof. If it isn't *your* station, it will eventually be someone else's. What you want to do is to plug the hole before the rain comes.

At this point, you're ready to talk about the set makers and the way they will supply a HP filter. So you tell the TV owner you can get him the filter by working through a regular service man or your Club TVI Committee (you should have one—both a club and a committee). This invariably leads to Indian Number Four.

"Why should I spend a cent? You do it." (Pay for the service call, or install the filter.) You see, the TV set owner has, in his own mind, paid the last cent he expects to for the best TV he can buy. Now you're telling him in effect that he's been had—or so he thinks. And wait until your TVI complaint comes from a man who works for the set maker!

You have to assume (dangerous!) that Mr. Madguy can still be logical about this, but here is a tried and trusty answer. "You can see from what we've been saying that the fault isn't with my transmitter, because the FCC would clobber me in a minute if it were. So what you're asking me to do (pay for a service call) is not only to get you *free* a $5.95 piece of equipment, but then to pay for putting it where your set maker should have in the first place. You see, the FCC (the more you can mention Fox Charlie Charlie the better!) says that the TV set makers *know* they should do this, but they take a calculated risk. Out of the thousands of sets they make, how many do you suppose might land, like yours did, near one of the 200,000 hams in the country? And a filter that might cost $3.50 at the factory, installed, could raise the final cost of the set as much as $25.00 or so by the time you figure in labor, mark-up for the Distributor, the Dealer and all the other people who get into the sale. That's why your set *needs* this filter —just a matter of economics. And since you are going to get the filter *free* from the set maker, doesn't that *prove* he knows his sets are not as perfect as they might be? Putting the filter in only takes a couple of minutes, and there won't be any parts charge, just a service call."

This leads to the other related question; "Well, why don't *you* install it?" If you want to take a chance, go ahead. But we don't recommend it. First of all, let *anything* go wrong with that TV set for the next six months, and who do you think will be blamed? Second, your neighborhood servicemen get touchy if they think you're doing them out of a service job. Use the first fact to avoid the second. *Don't get your fingers into the goodies.* Leave it to the service man. And if your neighbor is adamant about not spending a cent, tell him you'll see that he gets the filter as a courtesy, and that your responsiblity ends there. Exit gracefully (if possible) and go on the air when you please. Eventually, he'll figure that he has the filter, and he might as well install it. As a matter of fact, if you show him how easy it is, Mr. Madguy just *may* do it to save the dollar or two he's so worried about! But don't you do it for anyone less closely related to you than your landlord or your wife's Cousin Jake.

Fifth Lurking Redskin—*"You must be interfering; my TV looked (sounded) awful last night!"*

Just maybe you'll be lucky. Last night may have been the night you fried your final (these things *do* happen) Or maybe it was meeting night at the Club. Anyhow, quickly explain the log and what it must show by law. Prove you weren't anywhere near the mike or the key if you can—and half your battle is won. Then try this. "You know, there are many things besides ham stations that can interfere with a TV set, but hams usually get the blame. (You can't duck it if she or he has heard your call signal, bub:) I'd like to help you find out what is interfering with your set. What does the interference look (sound) like?" Many times you can identify its source—like a fluorescent light in the next room that drove our committee bats for a while, or cars going by. Look around for a second set in the house that's beating against the one complained about—or an FM radio. And try to describe "typical amateur interference patterns" so they can compare your description with what they have on their set. You may end up with a clean bill of health. (The ARRL publishes "Patterns of Interference"—a chart you can get for the asking.)

Sixth Indian from the neighborhood warpath is *"What d'ya mean it's my set?"*

"Well, Mr. Madguy, *I* have two sets home. One is right in the same room with my transmitter and nothing interferes with it. I'd like to ask you to come over and see for yourself. (Better be sure your own TV *is* clean!) And I'd like to show you how a ham station is built and filtered so that it won't cause interference. (In the rare event that he does come over, contrast the shielded chassis of your rig with the open construction of TV sets. Compare coax with TV wire and lead-ins. Show him your low-pass filter and explain it in layman's language—of course you have an LP filter in the line, don't you?) If he won't come over—quite likely—talk him through what you would show him. Then add on as many cases as you can from the neighborhood of TV sets that aren't being interfered with while his *is* bothered.

(Continued on page 59)

Bill Roberts W9HOV
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Measuring Co Ax Feeders and Stubs

RECENTLY a brainstorm sent me into intimate consultation with a full set of handbooks and a slide-rule. This resulted mostly in several pages of calculations and a desire to do something else less mathematical. The antenna never did emerge from the confusion of figures, but an interesting chart did.

This chart shows the length of a half wave in free space, the length of a half wave of co-ax such as RG8/U, RG11/U, RG58U, or any other co-ax having a velocity factor of 0.66, the length of a quarter wave of co-ax (half the former, of course), and a multiple of half waves that will give you an all-band co-ax feeder.

Now let us take a hypothetical case and see what the chart will do for us. A half wave feeder for 28,600 kc would be 11.35 feet, or 11 feet 4 inches. A quarter wave stub would be 5.68 feet (5'-8"). It is interesting to note that a line 45'-7" would be 4½ waves on 10, 3½ waves on 15, 2 half waves on 20 and one half on 7 mc.

In multi-band antennas it is often advantageous to have a feed line that is ½ wave long. If you can choose a feedline that is ½ wave long on each band you may solve many problems. As you look down the chart you will see that there is a length around 45-46 feet that works out to be a half wave multiple on all bands. The CW operator would be more interested in the 46 foot length, the phone man around 45.4' or so.

This chart is for co-ax, not for open wire lines or twin-lead.

. . . W9HOV

	28000	28100	28200	28300	28400	28500	28600	28700	28800	28900	29000	29200	29400
½ Wave	17.57	17.51	17.45	17.39	17.32	17.26	17.20	17.14	17.08	17.02	16.96	16.90	16.84
½ Wave Coax	11.60	11.56	11.52	11.48	11.43	11.39	11.35	11.31	11.29	11.23	11.19	11.15	11.11
¼ Wave Coax	5.80	5.78	5.76	5.74	5.72	5.70	5.68	5.66	5.64	5.62	5.59	5.57	5.55
4½ Waves ...	46.40	46.24	46.08	45.92	45.72	45.56	45.40	45.24	45.08	44.92	44.76	44.60	44.44

	21000	21075	21150	21225	21300	21375	21450
½ Wave	23.42	23.35	23.26	23.18	23.10	23.02	22.94
½ Wave Coax	15.45	15.41	15.35	15.30	15.25	15.19	15.14
¼ Wave Coax	7.73	7.70	7.68	7.65	7.62	7.60	7.57
3½ Waves ...	46.40	46.24	46.08	45.92	45.72	45.56	45.40

	14000	14050	14100	14150	14200	14250	14300	14350
½ Wave	35.14	35.02	34.90	34.77	34.65	34.53	34.40	34.28
½ Wave Coax	23.19	23.11	23.03	22.95	22.87	22.79	22.70	22.62
¼ Wave Coax	11.60	11.56	11.52	11.47	11.43	11.50	11.35	11.31
2½ Wave ...	46.40	46.24	46.08	45.92	45.72	45.56	45.40	45.24

	7000	7025	7050	7075	7100	7125	7150	7175	7200	7225	7250	7300	7350
½ Wave	70.28	70.04	69.80	69.54	69.30	69.04	68.80	68.56	68.33	68.08	67.84	67.60	67.36
½ Wave Coax	46.38	46.23	46.06	45.92	45.72	45.56	45.40	45.24	45.08	44.92	44.76	44.60	44.44
¼ Wave Coax	23.19	23.11	23.03	22.95	22.87	22.79	22.70	22.62	22.55	22.46	23.38	22.30	22.22

Ohmmeter Polarity Test

Most multimeters are wired so that the black lead is positive and the red lead negative when measuring ohms. But not all are wired that way. When testing diodes and electrolytic capacitors, it helps to know for certain which way particular meter you grab is wired. If you don't happen to have a second meter to test the polarity, you can use a common potato to determine which lead is plus. The plus lead area turns bluish after a bit if you stick both leads into the spud.

A much better method is to simply use the ohmmeter to charge up any capacitor, 0.25 mfd or larger, then disconnect the capacitor, switch to the dc voltage range, and reconnect the capacitor and see which way the meter needle kicks.

This same charged capacitor is frequently used to advantage to measure dc voltages in extremely high impedance circuits. The capacitor is connected to the circuit (through an isolating resistor if needed) and allowed to build up to a full charge. Then a VTVM or dc Scope is connected to the capacitor and the reading quickly made before the charge leaks off. Naturally a good capacitor is essential, such as a mylar or polystyrene type.

. . . K6EAW

Automation

Jim Kyle, K5JKX/6

With a Vengeance!!

As I opened the door to the shack, Joanne put down her well-chewed pencil and turned off the big switch. "Yes, inventor," she said, "I see you're home."

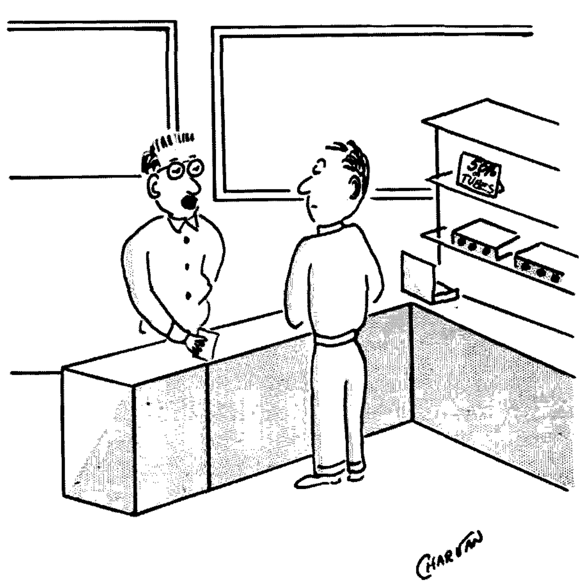
"Rough day at the salt mine," I grumbled, sinking my lanky frame down gingerly on a box of old 304TLs. "Too many computer circuits. . . ."

"You'd think," mused friend wife to no one in particular, "that with all the gray matter this cat's supposed to have, he could figure out a way to make a station do all its own dirty work. After all, they have machines that build more machines. . . ."

"Yeeow!" I cried, leaping to my feet. A 304TL had given way. But even after the surgeon removed the last splinter of glass from my posterior, the memory of Joanne's suggestion stayed with me piercingly.

Three reams of scratch paper, two gross of pencils, half-a-dozen editions of Terman (and two jobs) later, the evil deed was done. A complete circuit for a fully-automated ham station repcsed in my mind. It hasn't yet been transposed to reality . . . for reasons which shortly will become clear. But it *can* be done, and you're welcome to it if you want to try.

Before I send you muttering back to the crystal-set league, though, (and above all don't dare look at the schematics yet!) I guess I'd better outline what this super-duper station will do for you. Like she said, it does all its own dirty work. E.G.:



"I NEED 1024 RELAYS AND 2^{1024} DIODES."

1. Turns itself on and off.
2. Monitors for Conelrad alerts continuously.
3. Takes care of all transmit-receive switching.
4. Changes bands automatically.
5. Tells you what's happening at all times.

and 6. Keeps the log.

Those were the design specifications, and they were all met. It took a bit of doing, and many of the circuits are not the familiar ones you're used to seeing.

If you're ready for the shock, though, take a peek at Fig. 1. It's a combined block and logic diagram which shows the overall picture (and when one of these is finished, overalls will be the only thing you could afford, but that's ahead of the story . . .) in a more-or-less understandable way.

The big X in the upper left marks the spot where a switch goes. This is no ordinary switch, though. You know these mat-type footswitches that work by pressure? Take one of those and put it under the cushion of the chair in the shack. . . . Now, whenever you sit down, the station turns itself on.

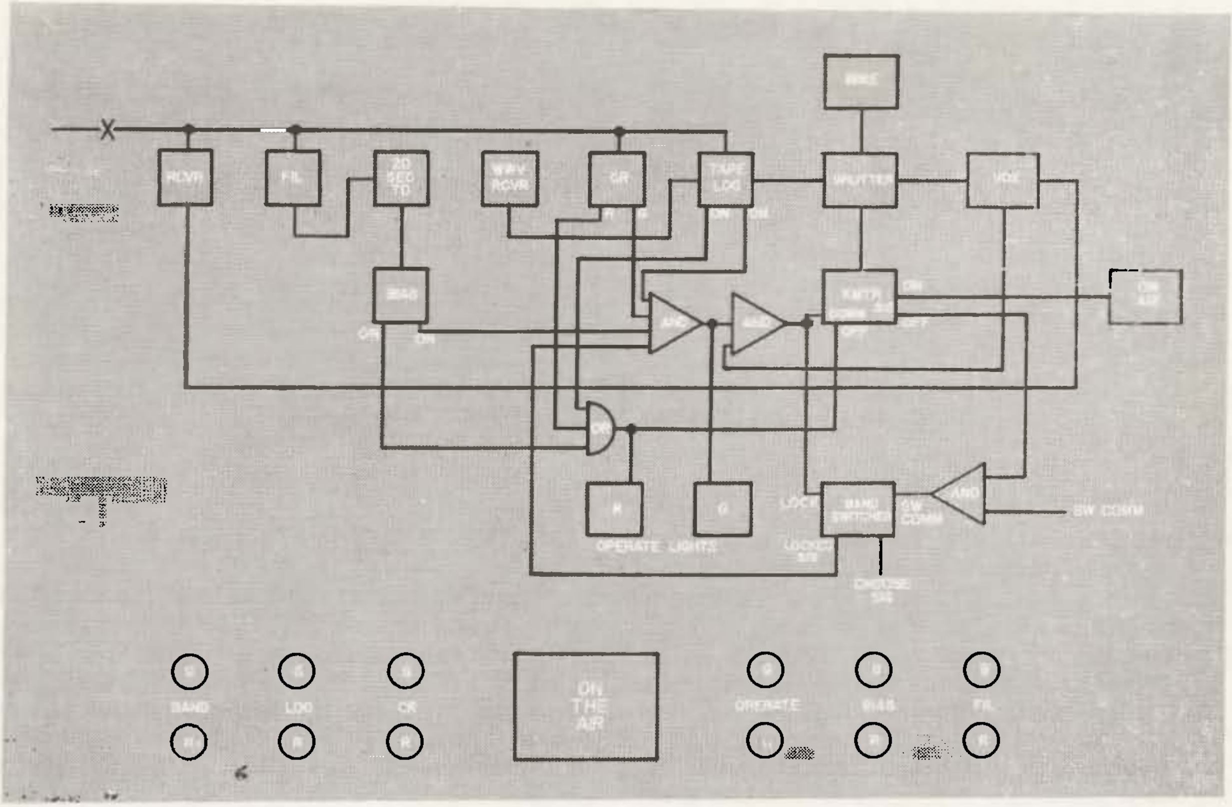
There, that wasn't too painful, was it? Now read on to the right until you come to the box marked "20 sec TD." This houses a 20-second time-delay relay which delays operation of the transmitter bias supply until all filaments have had a chance to heat.

Skip the box marked "WWV Rcvr" for the moment and concentrate on the one labeled "C. R." In its confines nestles the Conelrad alert monitor. Instead of the ordinary system of buzzer or pilot light, the output of this alarm is just a SPDT relay. When all is well, the "G" output line is connected to —12 volts. When the alert sounds, the —12 voltage is switched to the "R" line.

Now move on to the "Tape Log" box. This houses the much-modified tape recorder. The tape recorder has two inputs, as well as an automatic stop to halt it when it runs out of tape, and a relay in its B+ line which switches —12 volts to either the "On" line if all is working or the "Off" line if something fails.

Back to the bias supply. It, too, has one of these little relays, connected in a voltage-sensing circuit so that —12 volts is on the "On" output line until bias rises to rated value. At that point, the signal switches to the "Off" output line.

We skipped the "WWV Rcvr" before. Go back. This can be any additional receiver (a command set will work but a 51J is recommended) which will pick up WWV. With its own antenna, it is permanently tuned to



WWV. Output feeds one of the inputs to the logging tape recorder, providing time markers.

We're almost up to the transmitter itself by now, and the whole confusing mess is about to get really uncomprehensible. At this point, you have to open or close the gates.

The gates, that is, which control the transmitter. They're "and" and "or" gates, swiped from digital computer circuitry (it's cheaper to swipe them—the commercial models cost $25 each!). The smaller "and" gates can be built in the same manner by omitting two legs.

Note that each gate includes a —6 vdc supply, so that in the "and" gate you have to have —12 at each of the input terminals before output voltage will rise to —6 from zero. In the small gate driven from the large one, replace the 6-volt battery with a 3-volt one.

Now, after you sit down (automatically starting the cycle), the bias supply comes on after 20 seconds and the Conelrad and Tape Log equipment sends out "G" and "On" signals respectively as soon as warmup is over. Assume that the "Band Switcher" also has —12 volts on its "Locked Sig" output line, and you can see that the first "and" gate in the transmitter control chain is enabled. This puts —6 volts at the input of "and" gate No. 2. When it gets another —6 volt signal from the vox unit, you're on the air.

On the other hand, should Conelrad sound an alarm, the bias supply fail, or the tape log unit run out of tape, one of the enabling signals will be absent. In addition, a failure signal will go to the "or" gate in the disabling side of the transmitter control, and you're silent.

The fault locator panel consists of red and green pilot bulbs slaved to the enabling-signal lines. My out-of-this-world dreaming did it with transistor switches at each of the 13 bulbs, but it might be cheaper to use DPDT relays instead of SPDT in each signal line and control 6.3 VAC for the pilot bulbs with the other relay pole.

The "Operate" section on the panel, you may notice, is connected to the output of the big "and" and the "or" gate. If all is ready to transmit, the "operate" bulb lights green. If there's any failure, it lights red. If this bulb is red, at least one other will also be red, pinpointing the trouble. After a few months' practice, fault location with this system should be almost as fast as by the old try-everything-until-you-find-what's-wrong technique.

So far, we haven't looked at the "Band Switcher." It's a flip-flop connected so that when the transmitter is on, no signal can get through to a stepping relay which operates slave relays in each stage of the transmitter. If the transmitter is off, the input "and" gate is enabled, and you can pulse the stepping relay (approximate cost, $45) with a pushbutton on the arm of your chair. This steps you from band to band. An added refinement would be a series of pilot lights to let you know what band you're on, but I felt it would be a useless complication.

Note that the "Band Switcher" is connected to the transmitter coming and going, so to speak, so that the transmitter must be off before it can be turned on. This is a precaution against accidental doubletalk. For intentional

(Continued on page 58)

Art Korn K8HDR
4212 17th Street
Wyandotte, Michigan

Audio Boosting
The Command Receivers

SOME time ago I needed a receiver that was light weight and portable. Not wanting to carry around the 60 pounds of station receiver, a BC-779, I decided that if the audio of a command receiver could be improved enough for speaker operation that it would be the right size and weight. Also, the BFO was needed for CW reception. A check thru all the old magazines and handbooks brought little of help to light.

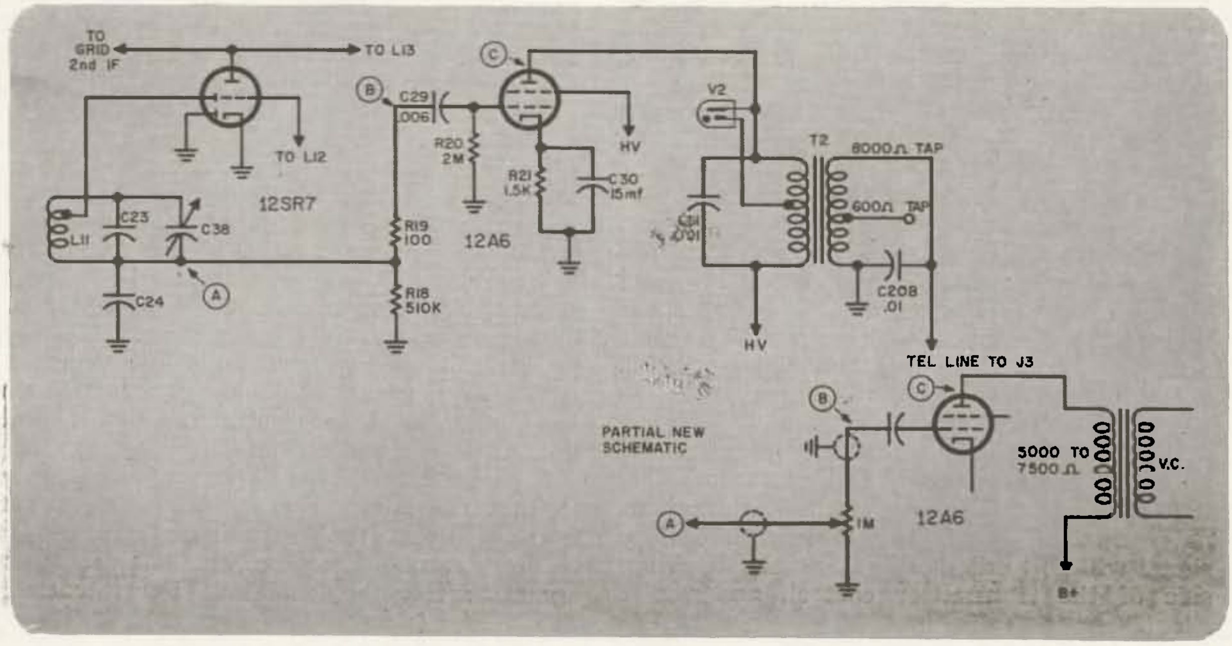
For portability the power supply had to be on the dynamotor well and be transformer operated for safety. This left no extra room for an additional audio stage.

It didn't take much staring at the circuit diagram to see that the reason we were not getting much audio out of the receiver was that it was designed to feed an external audio system or a pair of headphones. Simply by changing the output circuit a bit and using a regular output transformer we could have plenty of decibels.

Do It Yourself

Remove the screws that hold the two multiple condensers C20 (2X.05) and C16 (3X22mfd) and the audio choke (L15). Locate R19 (100K) and R18 (510K) under the two condensers on the terminal board and remove. The green lead that goes from these resistors to C29 (.006mfd) should also be removed. Solder a shielded lead to this condenser, ground the shield, and loosen the screws holding the other condensers on this side of the chassis to run the lead to the front panel. You might as well take out the coil box across the front of the receiver at this time. Leave this lead long enough to fasten to a volume control which will be on the front panel later. The af choke (L15) and its wiring might as well be taken out completely too. The black lead at the junction of the resistors should be pulled back to the *if* can pin and removed. Replace this with a shielded lead,

The only changes necessary are where new leads should be connected at points A-B-C.



ground the shield at the terminal board, and run this lead to the front panel also. These leads should be insulated from touching the sockets and causing an accidental short and only need to be insulated because there is no voltage but some BC pick-up due to the length and broadness of the *if*'s.

Re-fasten all the condensers and go to the other side of the receiver. Loosen the screws that hold the BFO (Z4) and C15 (3X.05) and output transformer T1. Remove the plate lead at the socket of the 12A6 and B plus lead from the power connection, and C31 (.001). Remove the wire to the phone jack, move all grounds from the phone jack to a direct chassis ground installed at this time in any convenient spot at the side of the chassis, and remove the phone jack. This is where you will put your volume control.

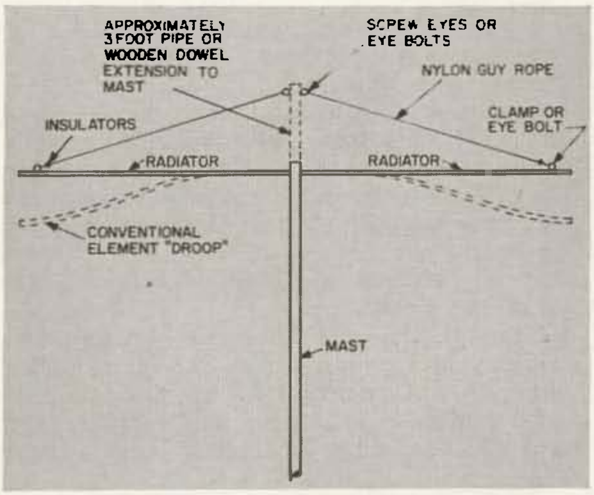
Now start putting a few parts back in! A small 5000 to 7500 ohm to voice coil output transformer should fit in where T1 was taken out. Be very careful when you move the BFO can and the condenser out of your way since these leads break very easily. Solder in the plate lead of the output transformer to the plate of the 12A6 and the B plus lead to the power socket. Run the voice coil leads either thru a convenient hole or to the unused pins on the power socket. Mount a one meg pot on the front panel and solder one lead to the center post, one to the end post, and the shields to the third post. Tighten down all condensers, coils and BFO can securely.

While you are under the chassis it might be well to take out the neon bulb across the antenna trimmer. I found this helped considerably. I left the old gain control in as this helps to cut down background noise on CW reception, but it can be taken out if desired.

Did it Work?

Now tie on a speaker, turn on the power, and grab something for an antenna. As soon as it warmed up, signals began to bounce thru that I had never heard with this receiver before. I tuned thru the 80-75 meter band and found the results of this little change were most gratifying for the time, parts, and effort consumed. For a stand-by receiver or for the Novice just getting started it is a truly fine receiver to work with. It is a little broad in the *if*, but curing that is another story. . . . K8HDR

Pick Up the 'Droop'



GETTING a bit tired of the "down-in-the-mouth" look of the drooping elements on your rotary beam antenna? Next time you have to service it or when you erect a new one, put a short extension (approximately 3 feet) on your supporting mast. This can be of metal or wood, as you elect. Most lumber yards carry what is known as "full round" stock in several diameters; one will probably fit your mast. If not, a little shaving will fix it.

Ordinary screw eyes (galvanized) in a wooden extension or the equivalent in eye-bolts for a metal pipe, placed at the top, will serve as the upper anchors for the guy lines. Drill through the rod elements near the outer ends to provide an anchorage for the guy lines by means of an eye-bolt or use a wrap-around clamp such as sold by most hardware stores for plastic pipe.

Use Nylon guy cord (any radio distributor) which is non-shrinkable, non-stretchable and of excellent tensile strength. Avoid *wire* of any kind for such guys; it could upset your radiation pattern! Break the Nylon cord with a small 'goose-egg' insulator close to the element. Insert a small galvanized turnbuckle, if you like, close to the top anchor of the guy lines. Glass line is also excellent for this.

Pick up the droop in each element this way; your beam will present a much more workmanlike appearance and the addition of such guys will stiffen the entire assembly surprisingly. It's weight is negligible and the cost is peanuts.

Howard S. Pyle W7OE

Transistor Modulator

Forty Watts

Monroe McDonald KL7DLC

THE unit I am going to describe in this article is a very efficient audio amplifier suitable for use as a plate modulator for a mobile or portable medium power (sixty to ninety watts rf) transmitter. The audio output is rated at forty watts, but the unit has delivered in excess of sixty watts to a dummy load. No audio quality tests were made at this power level, though. With no filaments to heat, the unit need not be energized during standby (receive) periods, so there is no standby drain. When the unit is energized during transmit periods, the idle drain is less than half an ampere at twelve volts, and the drain at full rated output (forty watts) with a sustained tone is less than eight amperes.

The unit as I use it is built into a power-supply-modulator unit, with a 600 volt 200 mil transistor power supply, so that plenty of "punch" may be supplied to a single 6146 rf section without straining. The power supply uses a *Triad* toroid and the circuit supplied by the manufacturer, so I won't concern myself with it in this article, except to state that the power supply puts two kilocycle noise onto the twelve volt line that takes several thousand microforads of filter capacity to keep out of the modulator.

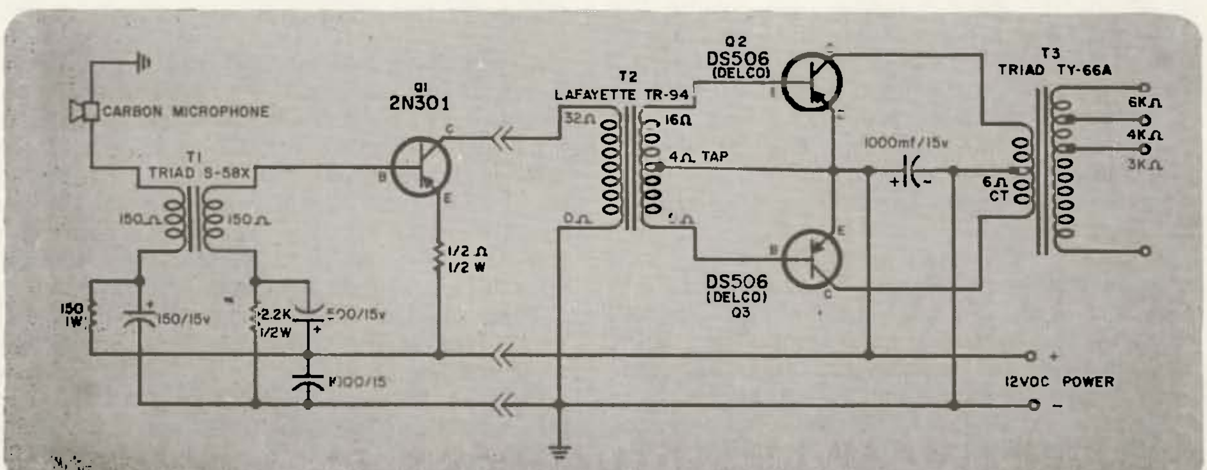
Although the modulator was designed with efficiency and power out as the main goals, I was pleasantly surprised to find that the audio quality is quite good, and compares with fixed stations in "naturalness." I use a carbon microphone, converted to use a Western Electric F1 telephone button.

The modulator and power supply, plus all the associated relays, filters, etc., are mounted in a box about ten by five by four inches, with the modulation transformer sticking out on top. The driver transistor and microphone transformer are included in the rf section of my rig, however, because that is where the mike plugs in, and I wanted to reduce mike lead line pickup.

The modulation circuit is very simple, and therein lies one of its virtues. The construction is nearly all mechanical, with not much wiring to do once the transformers and transistors are mounted. I did mount a terminal strip near the driver transistor to provide tie points for the components in that part of the circuit.

One unfortunate aspect of this unit, or any using recently developed components, is that the parts must nearly always be purchased new. Few people have transistors or transistor transformers in the high power category in their junk box. Using all new parts this unit will cost around forty dollars, and this might discourage those after economy.

The most important part of this modulator is the output stage, which may be used with any speech amplifier capable of delivering a watt or so. This way, microphones other than carbon may be used, or screen-modulated transmitters, such as the Heathkit mobile,



could be converted to plate-modulation, effectively increasing the power output four times. A driving transformer should be used to match the driver tube or transistor to sixteen ohms center-tapped (due to the impedance-match square law, the center tap for sixteen ohms is four ohms.)

Confused by all the complicated bias networks I saw in transistor amplifier circuits, I experimentally determined the characteristics of the transistors I had decided upon, and designed the circuit over two years ago. I have since seen similar circuits in lower-power application with the name zero-bias class-B amplifiers. The output transistors are biased slightly below cut-off by returning the base circuit to the emitters, making full class B operation. This is supposed to introduce some distortion, but it is not noticeable in my unit. The driving impedances of the transistors were also determined experimentally, as Delco would supply no information on the use of their transistors in such applications.

The driver circuit was designed as a class A amplifier using RCA characteristics, and input and output impedances. Since the input impedance of the driver and the output impedance of the carbon mic are about the same, I first tried capacity coupling between the two, but found the stage tended to oscillate because of collector—base coupling through the twelve volt line, even though that line was well-filtered. With a mic. transformer, the phase may be reversed to cancel this feedback. The mic. transformer by-pass filter capacitor must be returned to the emitter supply line, and not ground, to prevent oscillation. The base resistor was selected to give approximately 375 mils idle collector current, and turned out to be 2200 ohms in my unit.

No gain controls have been provided in this circuit, as I believe none are necessary in mobile operation, where the same operator uses the rig all the time. The overall gain may be initially set up by juggling the value of the mic. bleeder resistor, so long as the mic. button current does not exceed about fifty mils. I use about forty mils button current, to get full modulation with my normal speaking, and the 150 ohm resistor was selected for that purpose.

Very heavy filtering is required across the power input to the audio output stage because the current drain varies greatly with modulation, and unless the modulator is connected to a battery with very short, heavy leads, an unfiltered modulator can modulate the twelve volt power line, causing serious circuit interactions. Heavy filtering across the driver is required to reduce receiver and transmitter power supply noise fed into the audio from the twelve volt line. At power transistor impedance levels, heavy filtering means capacity in the thousands of microfarads.

In construction of this modulator unit the transformers should be located according to good audio practice to minimize magnetic coupling. In my unit, the mic transformer is in the rf unit with the driver transistor, the driver and output transformers are at opposite ends of the modulator unit and at right angles to each other, and the power supply toroid is near the output end, as far as possible from the lower level transformer. The output transistors are mounted through the outside of the box using the mica insulators and hardware supplied with them. The driver transistor is mounted on the back sheet of the rf section's metal shell with a mica insulator I made from material kept by hardware stores for stove windows. The transistors must be insulated electrically, but not thermally, from ground, as the transistor shell is the collector connection, and the heat-dissipating element.

I use an F1 telephone carbon button for a microphone, and any other mic. might have different gain or other circuit considerations. This telephone button has very good gain and fidelity, but has the disadvantage that it tends to pick up traffic noise. The "communications" carbon mics. pick up less noise, and require louder talking.

I got the driver transformer on a special sale, and it might be difficult to duplicate exactly. It is much larger than necessary, however, so a smaller substitute might be an improvement. The requirements for the driver transformer are a couple of watts power capability, a sixteen ohm secondary with a tap at four ohms, and a primary to match the driver used, in my case thirty-two ohms, with a half-ampere rating.

The input impedance of the driver transistor is about seventy-five ohms, and as the carbon mic. output impedance is nearly that, a one-to-one transformer with as near to that impedance level as possible is used to couple them. The primary must handle fifty mils mic. current.

It should be borne in mind that the output stage of this modulator draws fairly heavy current, and the power leads, relay contacts, ground connections, etc. should be of sufficient size.

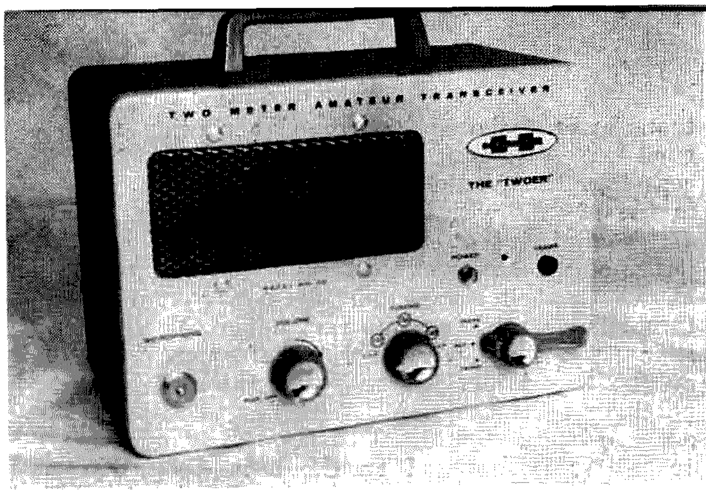
I hope that this modulator will work for other builders as well as it does for me.

. . . KL7DLC

Very Short Article

Toroid Tip

A wafer octal socket makes a nice tie point strip if you are building a toroid core transformer for transistor power supplies. Just bend the solder lugs down and attach the leads from the windings. VE6WT



Donald A. Smith—W3UZN
Associate Editor

73 Tests

HEATHKIT
"Twoer" HW-30
Two Meter Transceiver

Size: 7" x 9¾" x 6" deep.
Weight: 6½ lbs.
Power: 115 vac @ 45 watts.
Transmitter: 8 mc xtals.
5 watts input.
Receiver: Super-regenerative.
RF amplifier.
Tunes 144-148 mc (CAP & MARS).
Assembly Time: 7 hours, average.
Price: $44.95 (including mike).

If you'd like to know more about a complete 2 meter station for less than $45.00, read on! Latest in the Heath Companys' line of low priced transceivers is the HW-30, a two meter model, similar to the ten and six meter models. The size, shape and color of all the units are the same, though the insides of the Twoer are somewhat different.

Transmitter

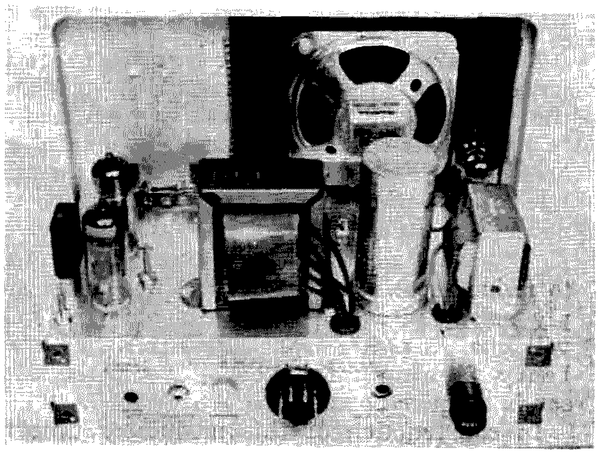
Regular 8 mc crystals with standard .500" pin spacing (FT-243 holders), are used in the oscillator. The pentode half of a 6BA8 tube is used as the oscillator in an electron coupled, Pierce oscillator circuit. The plate circuit of the oscillator is tuned to 24 mc, thus tripling in the oscillator. The second half of a 6BA8 (triode) takes the 24 mc output from the oscillator and triples it to 72 mc. The 72 mc signal is then fed to the triode half of another 6BA8 tube which doubles the signal to 144 mc and drives the final. The pentode half of a 6BA8 is the final, operating straight through on 144 mc.

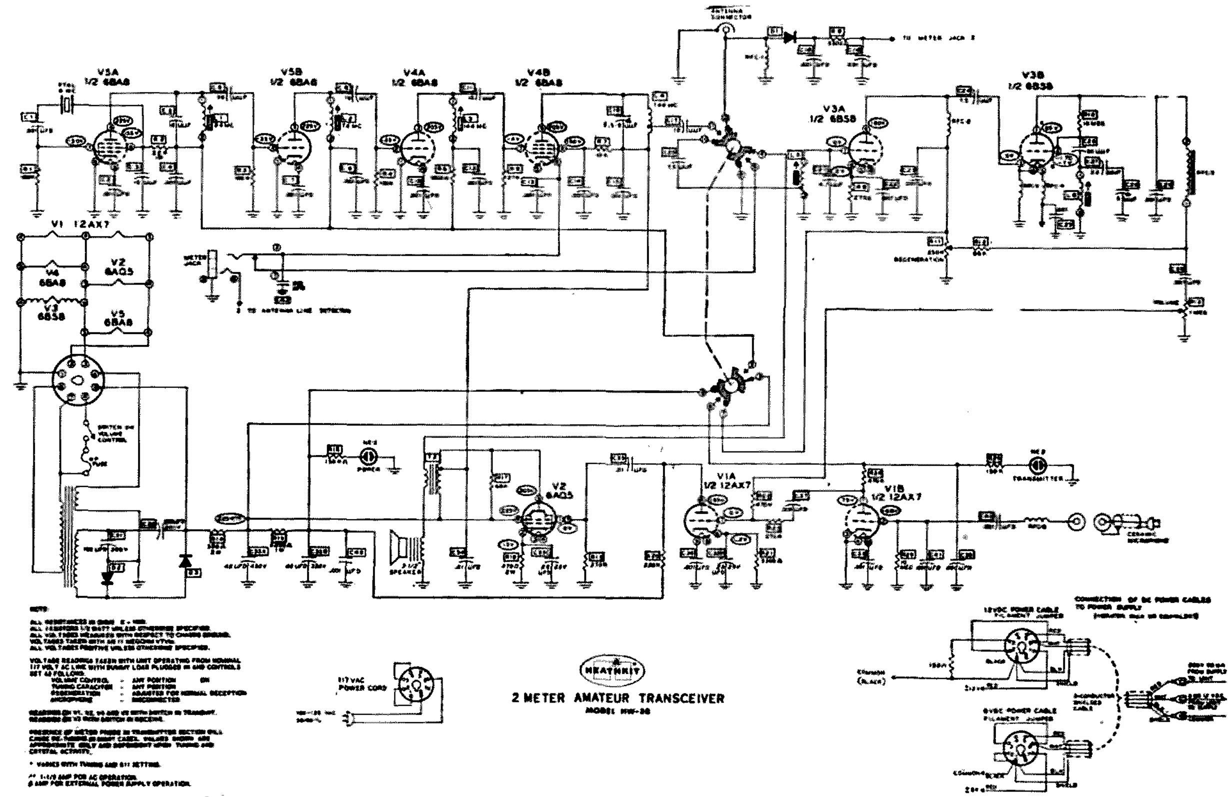
Bypassing in the transmitter is extensive, with over two dozen ceramic disk capacitors being used! All tuning in the rig is done with slug tuned coils, with the exception of the final, which is tuned with a 2.5 to 6 $\mu\mu$fd trimmer capacitor. The final coil is mounted right on the trimmer proper, to keep the lead length as short as possible.

Plate modulation is used, which gives you more "punch" than other types.

Receiver

The receiving section is very sensitive, even though a super-regenerative detector is used. Heath has improved on the standard super-regen by adding a tuned rf stage. A low noise 6BS8 tube is used in the receiver. One triode of the tube is used as the rf amplifier and the other triode as the super-regen detector. Some Amateurs have never used the super-regen, so I will mention that one of the problems with them that has always been annoying, is what is known as "suck-out." That is, as the receiving frequency is changed, the detector will drop out of oscillation.





Heath has eliminated this problem in two ways. First, they use impedance coupling between the rf amplifier stage and the detector and secondly they made the feed point of the detector a very low impedance. Thus when the regeneration control has once been adjusted properly, you can tune between 144 mc and 148 mc without any further adjustment of the regen control. It should also be mentioned that the super-regen is famous for re-radiating signals from the receiving antenna. The rf stage minimizes this re-radiation.

Audio

On receive, the audio section includes one half of a 12AX7 as a voltage amplifier, feeding a 6AQ5 output tube. A 3½ inch speaker is mounted on the front panel of the unit. One watt of undistorted audio is available in the receive position.

On transmit, the audio section becomes the modulator. One half of a 12AX7 tube is used as a mike pre-amplifier and the second half of the 12AX7 is used as a voltage amplifier, driving the 6AQ5 output tube. A tap on the output transformer is used to provide the proper impedance for the final rf amplifier, plate modulation being used. An rfc and .001 disk ceramic capacitor are used in the mike input to the modulator, preventing rf energy from re-entering the audio section during transmit.

Power Supply

A built-in ac power supply is included with the transceiver, using a power transformer. A full-wave voltage doubler circuit is utilized, using two silicon diodes. B+ output is approximately 260 vdc @ 90 ma. The supply is wired in such a way that an external dc supply can be plugged into the rear of the unit and all necessary changes in the rigs circuitry are automatically changed over when the proper cable is plugged into the rear of the unit.

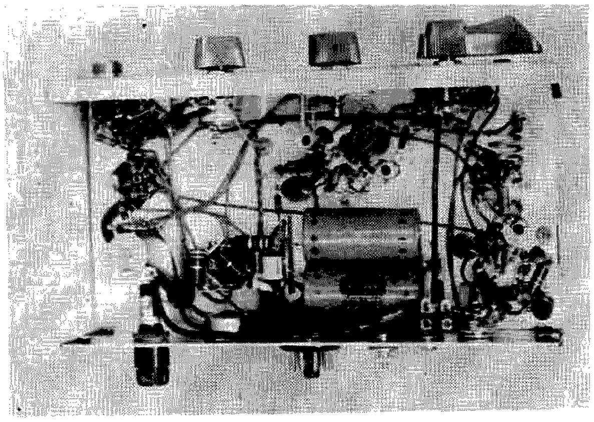
Building the Unit

Building the rig requires 6 or 8 hours to complete and should NOT be hurried. The design and layout has been carefully thought out, as long leads, parts placement and general layout become quite critical at these frequency. All capacitors used in the rf circuits (both receiving and transmitting sections), are disc ceramics and even tube sockets are of the ceramic, shielded types, for low loss. Note in the photos, that the bottom of the unit looks like there are hardly any parts used in the unit. It gives this appearance because the lead length was kept as short as possible. Actually there are 42 capacitors, 25 resistors, 8 terminal strips, 2 controls, 1 rotary switch, 6 rf coils and 6 rf chokes under there!

The filament circuit and the B+ wiring is done first, with the transmitter section following. The receiver section is then wired, with the power supply and front panel wiring done last. Parts are furnished for making one ac and one dc (6 or 12 volts), power cords.

Tune Up

The rig, as mentioned before, uses 8 mc **xtals** and when it comes to tuning up the rig, you're



glad it does as there are no tricky crystal feedback adjustments, or troubles with lack of "drive." To make the tune-up even easier for those not too familiar with these frequencies, approximate settings of all the coil slugs and the final tuning capacitor are given in the tune-up procedure.

(See diagram.) The oscillator is tuned to 24 mc with the slug in L1 being used to make the adjustment. The tripler is then brought to resonance with the adjustment of L2. The doubler can then be tuned by adjusting L3. The final is dipped by adjusting the final tuning capacitor, C16. There is only *one* dip possible in the final! The two meter model has a little different set-up on the meter plug than the other two models. The Twoer uses a two circuit jack, the first position being used to measure the rf output voltage with a standard dc VOM or VTVM. When the unit is tuned properly this voltage will be about 14 or 15 volts on a 20,000 ohms/volt meter. A diode and filtering circuit is built into the rig to provide this reading, which is helpful in tuning up the rig.

When the meter jack is pushed all the way in, (to the second position), the meter is placed in series with the final amplifier, permitting the final plate current to be read. Please NOTE that the meter can not be left plugged into the second position of the meter jack, unless the rig is actually switched to transmit (on the front panel), as the meter completes the final cathode circuit to ground and the final will be operating regardless of the front switch setting.

Receiver tune-up is very easy and a GDO, signal generator, or an on-the-air, two meter signal can be used. The adjustments include rf amplifier tuning, detector tuning and regeneration control adjustment. The receiver adjustments affect each other slightly, so the other adjustments must be checked after making any adjustments to the receiver coils or the regen control.

Checking Out the Rig

I have to admit, frankly, that I was really surprised at what the rig will do. The first station worked was about 45 miles away, on the *other* side of 1200 foot mountains and the signal report was 59! To top it off, I was using a six meter beam at the time! Later, working the same station with a two meter beam, signal reports were 59+++. There is no drift with the rig, nor any FM and modulation quality is excellent.

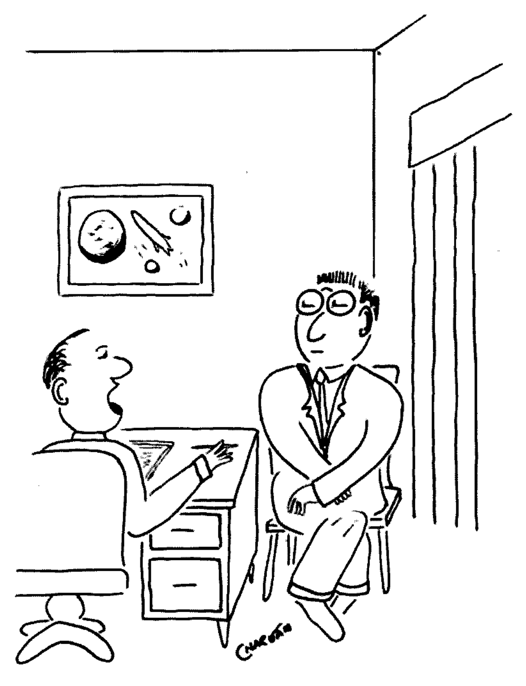
The receiver section is very sensitive and signals were heard often from Washington, D.C., Alexandria, Va., etc. Selectivity is nothing to rave about, as would be expected with this type of receiver. On the VHF bands this is seldom important. And for mobile use the rig really fills the bill.

The VP-1-6 (or 12), vibrator power supply is designed for Heaths' line of transceivers and one of these supplies will operate the 6 or 10 meter models from a six or 12 volt battery. The Twoer requires two of these supplies, however, as the B+ current runs about 90 mils on transmit, while the other models runs about 60 mils. The supplies are quite inexpensive, at 7.95 each in kit form, complete with tube and vibrator!

The six and ten meter transceivers can be bolted together, along with the Twoer to provide a complete 10, 6 and 2 meter VHF station for about $130. A single meter can be used for all three units when they are connected together.

All in all, there is a lot of fun to be had with the little Twoer. At $44.95 it sure is an inexpensive way to get on two meters. It is my personal hope that the rig will encourage others to come up on the higher bands.

. . . W3UZN



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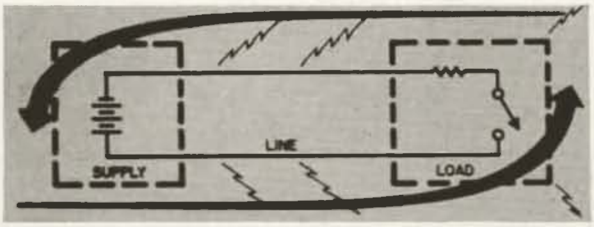
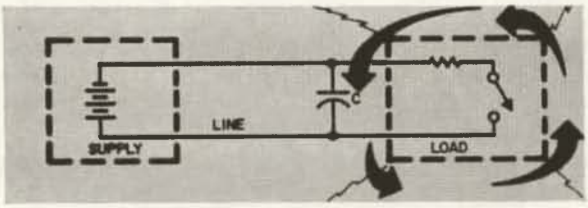
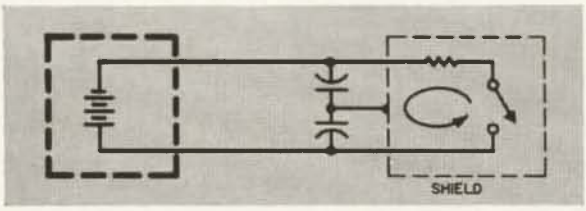


ANY electrical circuit that has a load that is alternately connected and disconnected from the supply voltage can be a source of radio frequency noise. Unless precautions in design and installation of this equipment is taken, severe radio and television interference may result. Units that use a brush type motor, vibrating load contacts, or neon-fluorescent lamps are good examples. This rf interference may be radiated from the unit or its supply lines or both.

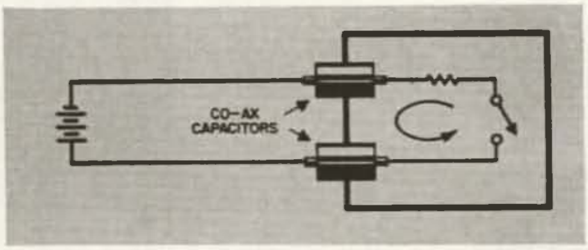
The radiation of this interference from the supply line can be reduced by installation of a capacitor across the line as close to the guilty device as possible.



This capacitor acts as a short return path for the noise and helps to isolate the line.



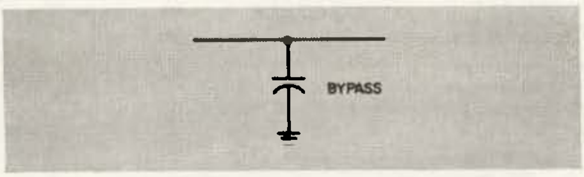
Complete shielding of the unit plus two capacitors will reduce radiation from both the line and the offending load unit. Notice that the use of two capacitors allows both sides of supply line to be effectively shorted out to the shield as far as the noise is concerned. At very high frequencies radiation may occur from even a very short length of wire. Capacitors that appear as low impedance shunts at low frequencies may not be on VHF due to internal impedance. A special type of capacitor called the co-axial capacitor has been developed that has very low internal impedance and is a very effective short circuit for noise from the low frequencies to the very highs.



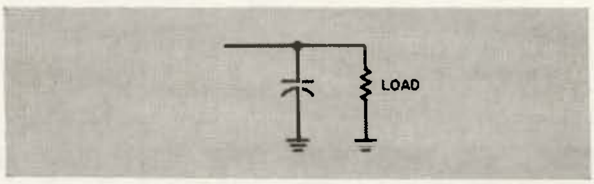
Radio Frequency By-passing

DC or low frequency ac current travels thruout the area of a conductor, but high frequency ac current travels closer to the surface. At frequencies above approximately 500 kc all energy is traveling on the outer surface of the conductor.

Bypassing of rf energy to ground (stripping noise components from a conductor) has been done in the past by use of a by-pass capacitor.

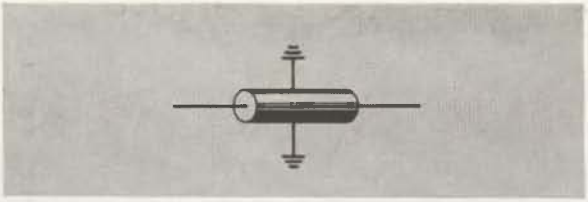


This is only partially effective, and is very dependent upon actual circuit conditions, particularly the actual impedance to the rf energy at the point of bypass.



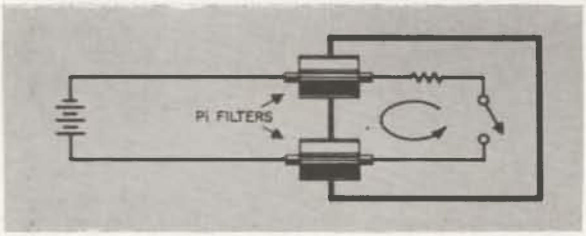
Given a by-pass capacitor that has a 10 ohm impedance (this is the sum of the capacity and its leads) and a load impedance to rf at this point of 100 ohms, then approx. 90% of the rf will be bypassed. If the load impedance to rf is 1 ohm, just as likely, then the bypass is only 10% effective.

A co-axial capacitor is so designed that it completely surrounds the conductor carrying current. Thus, all rf currents traveling on the surface of the conductor flow to ground.



The rf impedance of the load has very little effect, the amount of rf removed depending only on the quality of the co-axial construction and the capacitor installation.

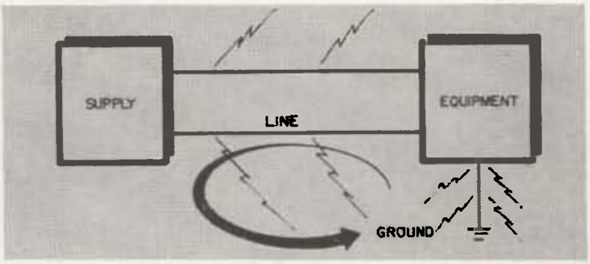
In unusually severe cases of rf interference or where suppression must be complete, a Pi type noise filter can be used. This consists of two special capacitors and an rf choke coil, so arranged that noise is effectively shunted inside the shield, isolated from the line, and the supply line is bypassed. These filters are supplied as single units as shown or as a dual



unit to facilitate mounting.

Occasionally a heavy ground wire from a well installed external ground, bonded to the shield around the interference generator will help, but many misconceptions exist about grounding equipment and its effect on noise suppression.

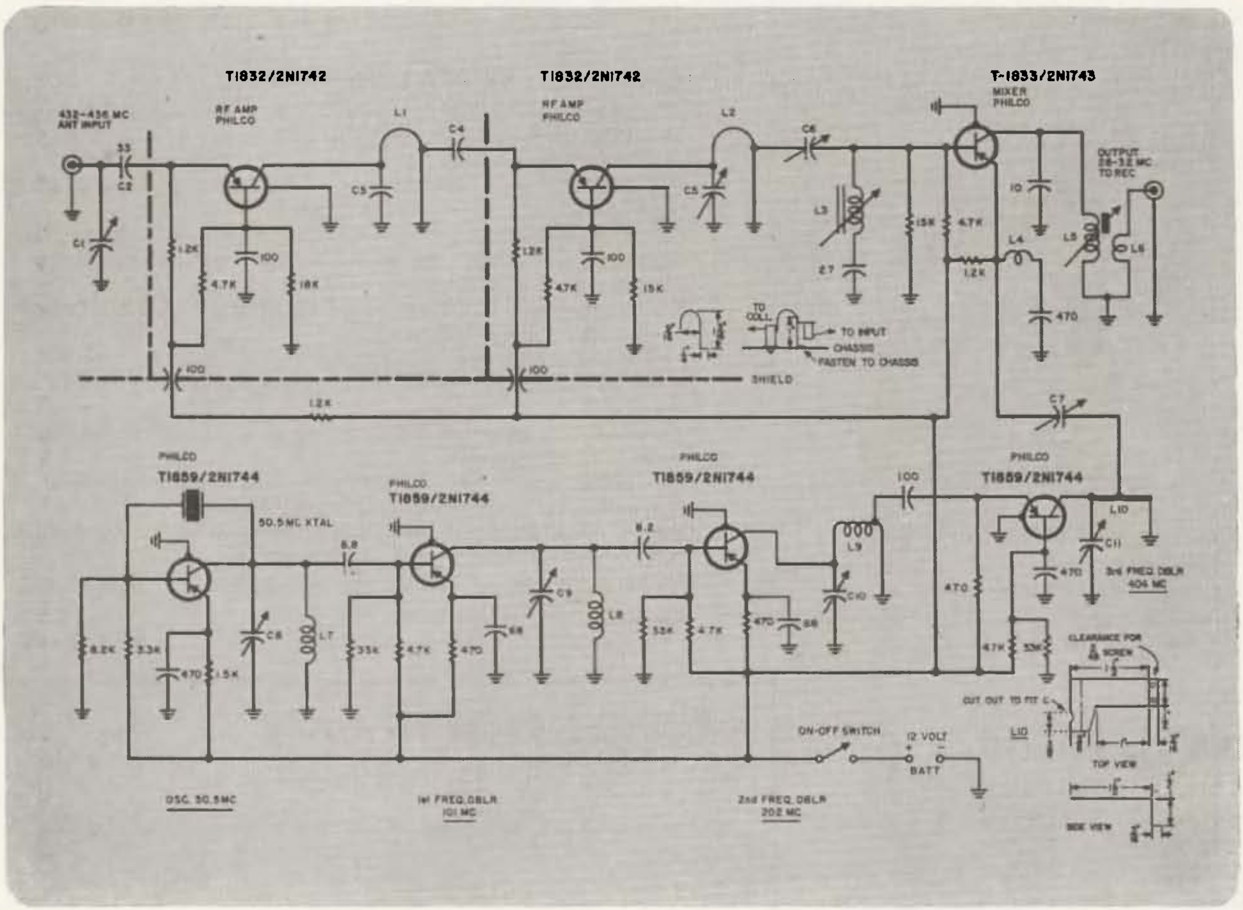
When the supply line is radiating the noise, a ground connection to the unit may increase the radiation.



Any lead carrying noise currents will radiate, unless completely shielded, and this includes long ground leads. The offending device must first be isolated at radio frequencies from its supply line; then fully enclosed in its shield; then a good ground may help reduce the remaining direct radiation from the unit and very low frequency noise. . . . K2TKN

432 mc Transistor Converter, Part II . . . W3HIX

(printed as a public service for those few hams that have to have a diagram)



Take Your Pick

or

Getting your fill of Filters

Staff

ONE of the most fascinating things about this business of ham radio (it says here in fine print) is that you can take your pick of conversations—with Europe, Asia, Africa, Australia, the Far North, Antarctica, or nearly any state of the 50. All you have to do is turn the dial of your receiver. . . .

And if you've been in this game for more than 15 minutes, you've undoubtedly wished to high heaven you *were* able to take your pick of the umpty-odd stations roaring through your receiver's selectivity curve and clobbering signals you're trying to copy!

In this country alone, there are nearly 300,000 hams and at any given time it's safe to assume 10 percent of them are on the air. The "popular bands"—75, 40, 20, 15, and 10—have a total of 1,650 kc of space allotted for A3 emission. That theoretically gives each ham something like 5.5 cycles all to himself.

Of course, there are several simple answers to the problem. They all add up to the same thing: increase your receiver's selectivity. However, the details of each answer differ.

By far the simplest answer is to rush out and buy a new receiver. No fuss, no muss, no bother. But be sure to get one which has noticeably better selectivity than the old rig—and be prepared to shell out more than half a kilobuck for it!

Most of us, for financial reasons alone, are forced to do something about improving the existing receiver. And, let's face it, most of the brand-new receivers in the under—$500 class could stand some improvement in the selectivity line.

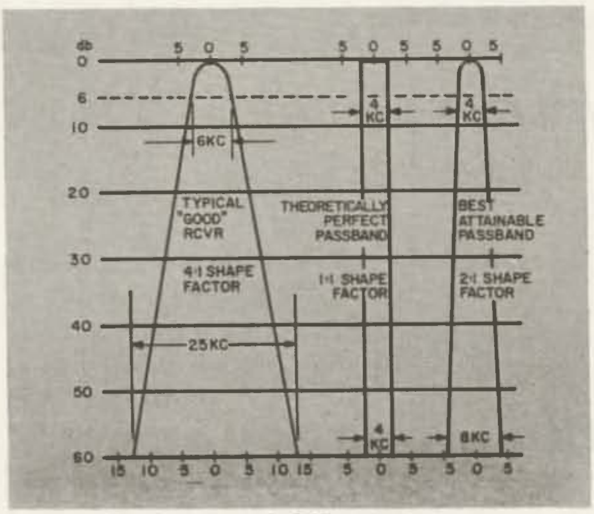


Fig. 1. Characteristic selectivity curves.

Literally hundreds of articles have been written in the past 10 years on improvement of selectivity. It's not possible to cover the content of all of them here. All the major points, though, are included—as well as some which seem to have been unduly neglected.

For a start, let's look at the various ways of achieving ideal selectivity. None will be successful in obtaining the theoretically-perfect 2-to-1 "shape factor" shown in Fig. 1, but some of them come pretty close.

The first thing that comes to most hams' minds when you mention selectivity is a filter. But there are filters and more filters. . . .

There are crystal filters and L-C filters, ceramic filters and mechanical filters, costly filters and costlier filters, and so forth into the night. And any of them, properly used, will do the trick.

Besides filters, though, the list includes Q-multipliers (either outboard or built-in), "Q-Fivers" and other multiple-conversion devices, and the "signal slicer" line of gadgets.

Properly used, any of these devices can cure the trouble of too many signals. Frequently, several of them may be used together to take care of the most stubborn problems. But if they're not used right, any of the gadgets can introduce more troubles than they cure.

Oldest aid to selectivity in the list is the single crystal filter, making use fo both series and parallel resonances in a single quartz crystal at the receiver's *if* frequency to achieve a passband peak and a rejection notch some 40 db deep. Its principles are gone into quite thoroughly in all the ham handbooks and won't be repeated here. Just one thing—for the simple crystal filter to work properly, the entire circuit must be carefully matched to the crystal. It's nearly impossible to hang one into an existing receiver with any degree of success, and equally difficult to substitute another crystal for the factory-supplied unit in a receiver already having a crystal. This is one circuit the homebrewer is well-advised to leave alone.

Don't misunderstand the preceding para-

graph. You *can* add a crystal filter to almost any receiver, easily and successfully. However, it won't be the simple, basic circuit. The crystal filter most favored for homebrew installation is the lattice circuit of Fig. 2. Many

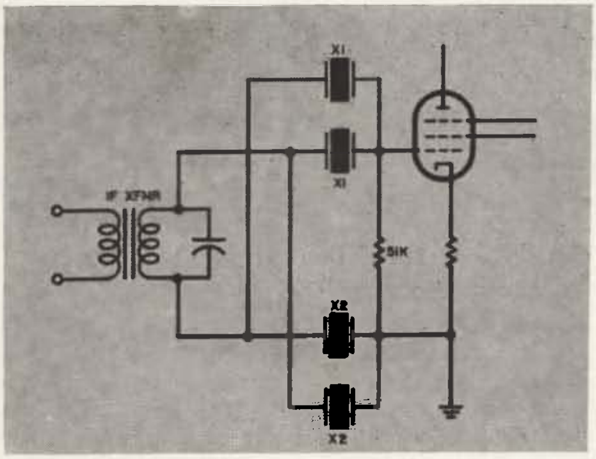


Fig. 2. Full lattice crystal filter. X1 and X2 should bracket the receiver *if* frequency and crystals of the same frequency must be within 50 cycles of each other.

variations of this circuit can be found in the literature, but there's little basic difference in the performance of any. Bandpass is determined by the frequency spread between X1 and X2, and will be roughly equal to twice the difference in frequency of the crystals. All crystals of the same frequency should be within a few cycles of each other. Don't trust the markings—rig up a simple oscillator and listen to the 3rd or 4th harmonics with a BC receiver. You may have to check a half-dozen similarly-marked crystals to find two close enough together for use in this circuit.

Advantages of this circuit include ease of construction, inexpensiveness if surplus FT-241 crystals are used, and general reliability. Disadvantages are the fixed passband and the trickiness of receiver alignment after such a filter has been added. Points to watch in construction are these: Keep the input and output of the filter well-separated to avoid a capacity path around the crystals, and be sure to put the filter as soon after the mixer stage as possible. Out-of-passband rejection averages 30 db with good construction technique. This is enough to help, but not enough to keep that California kilowatt down the street from getting through.

Another crystal-filter circuit operating on entirely different principles is shown in Fig. 3. This one is a complete substitute for the *if* strip of your receiver, and actually can be used to make a good separate receiver if you put an rf stage and mixer ahead of it and follow it with a simple detector and some audio.

This circuit makes use only of the parallel

(Continued on page 44)

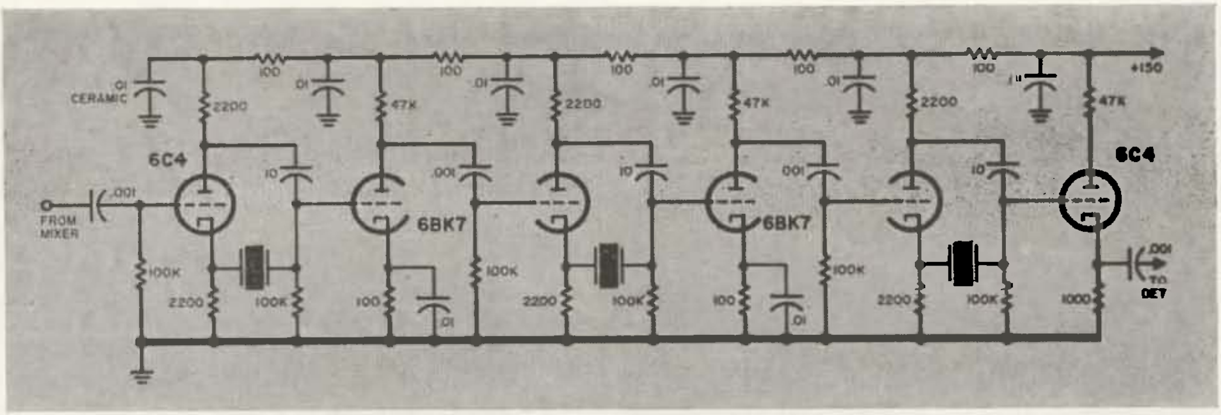


Fig. 3. Crystal coupled *if* amplifier. For CW use all crystals should be within 50 cycles of the same frequency. For AM reception they can be staggered ± 1.5 kc.

resonance of the crystals. Since the crystals provide the only effective coupling between *if* stages, signals must be at or near the crystal's resonant frequency to be amplified. Using 3.5 mc crystals with a frequency spread between crystals of 1 kc or less, the passband will be just about wide enough for an AM phone signal. If you drop the *if* to about 1600 kc and keep the crystals within 50 cycles of each other, you'll get an 80-cycle passband which is ideal for CW if your local oscillator is stable. With a 1600-kc *if* but staggered crystal frequencies (± 1 kc) the passband will again be right for phone use.

This is probably the simplest of all really effective filter circuits, since out-of-passband response is nearly 90 db down. Its major disadvantage is that it requires construction of a separate *if* strip. Even so, its cost is still lower than a mechanical filter—which is the only other type giving equal results.

Closely allied to the crystal filter in many ways, but possessing a few important differences all its own, is the ceramic filter. Developed by Clevite, this device has been used in only one commercial receiver for the ham trade—the Heathkit Mohican.

The ceramic filter operates on the same basic principle as the crystal—that of piezoelectricity. However, since the ceramic filter is manufactured by a process much like that used in making aspirin tablets, almost any desired characteristic can be built in to help cure selectivity problems fast . . . FAST . . . *FAST! !*

One of the first major differences was development of a "first overtone resonator" which shows only a series resonance, with all parallel resonance effects missing (fundamental resonators show selectivity curves almost identical with those of quartz crystals). The "first overtone" ceramic resonator is the electrical equivalent of a very-high-Q pi-network circuit, and as such shows much sharper cutoff above its resonant frequency than below. However, by combining resonator elements the manufacturer has developed a six-section filter with a shape factor of 2.25 to 1.

In application, the ceramic filter is more closely linked to the mechanical breed than to the crystal. It is supplied as a sealed component, with input, output, and common ter-

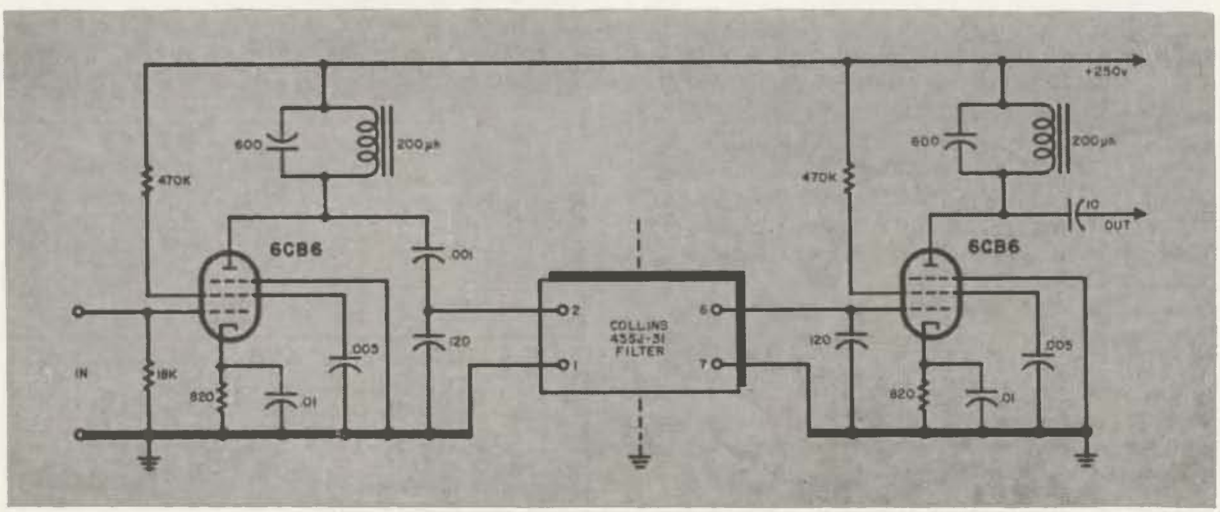


Fig. 5. Mechanical filter adapter. Be careful to keep the input and output of the filter well isolated from each other.

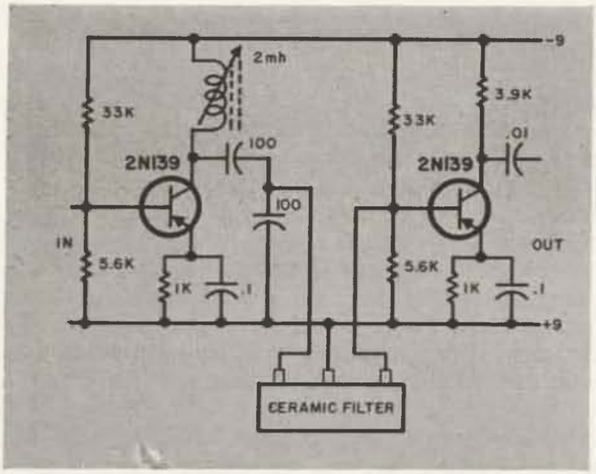


Fig. 4. Manufacturers recommended circuit for installation of a ceramic filter. Transistors are RCA type 2N139.

minals. Unlike other filters, it is most tolerant of variations in source and load impedance, performing equally well in a 2700-ohm circuit and a 10,000-ohm circuit with no change in characteristics. Available passband widths range from 4 to 20 kc at —6 db.

Since impedance levels can be low, the ceramic filter is ideal for transistorized circuitry. The manufacturer's recommended circuit for narrow-band applications is shown in Fig. 4. The only fly in the ointment is this: they're not readily available through ham supply channels. For the nearest distributor's name, you have to contact the manufacturer: Clevite Electronic Components, 3405 Perkins Avenue, Cleveland 14, Ohio.

One of the most popular filters which can be easily added to any receiver is the Collins mechanical filter, which features a 2.5-to-1 shape factor. Based on magnetostriction principles, it provides excellent characteristics with a minimum of adjustment. Its major disadvantage is cost: somewhere near $50, depending on just which of the several available models you get. Equivalent performance is available with other circuits for less money, but they take more time and trouble.

If the cost doesn't bother you, the mechanical filter can be added to your receiver by use of the adapter shown in Fig. 5. Nothing about it is critical except that isolation must be maintained between input and output of the filter to prevent leakage around it. Separate tubes instead of a twin-triode are necessary for the same reason.

Last on the list of filters is the L-C type. While it's possible to design and build a classic-line L-C filter to work at *if* frequencies, the simplest and cheapest way out is to use cascaded transformers as shown in Fig. 6. With the average receiver, addition of four high-quality *if* transformers as shown will in-

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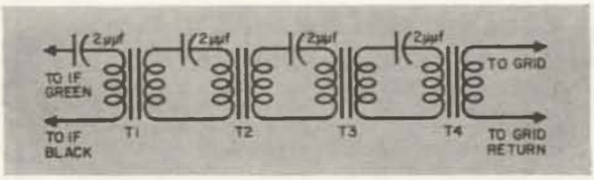

Fig. 6. L-C *if* filter. Use high quality *if* transformers for T1 through T4.

crease skirt selectivity noticeably. Performance won't be up to that of a crystal, ceramic, or mechanical filter, but will be well worth the time and trouble involved.

For best use of L-C filters, conversion to a lower *if* than the customary 455 kc is necessary—but that takes us into the "Q-Fiver" area. Even at the lower *if*, it's usually cheaper and simpler to buy the filter as a ready-made component from UTC or Burnell than to brew it yourself.

If your selectivity problem isn't so drastic as to require addition of a super-sharp filter —and even if you have added one—the Q-multiplier may be your answer. Popularized by Heathkit since its invention by O. G. Villard, this gadget makes use of controlled regeneration to mulitply the Q of a tuned circuit to astronomical values, thereby multiplying its selectivity as well. The resulting peak can be used either to boost or to null a signal, depending on whether you have one or many sources of interference in the passband.

A basic boosting Q-multiplier circuit is shown in Fig. 7, and the full rig including both peak and null functions comprises Fig. 8. Since the controls of the Q-multiplier have no interaction with receiver controls, you can add as many as you like—one in the plate of the mixer, another in the first *if*, etc. The peak or null will have a width approximately equal to 0.1 percent of your *if* frequency, and can be tuned across the receiver's passband.

The simplest of all Q-multipliers (although the term hadn't been heard of when the trick was invented) is that shown in Fig. 9. It requires no outboard circuitry, and the only addition to the receiver panel is a potentiometer which can be installed concentric-fashion with the rf gain control if you desire. C1 is a gimmick capacitor consisting of several turns of insulated hookup wire wrapped around the grid lead, with one end connected to the tube's plate terminal. Resistor R1 controls regeneration of the stage by controlling its gain. R1 will also act as an additional gain control. This circuit works by turning an *if* stage into a regenerative amplifier, which adds "negative resistance" to its associated transformers and greatly increases their Q and selectivity. It has been successfully applied to the S-38 and to the Command Sets.

One popular means of improving selectivity is through use of a "Q-Fiver." While the BC-

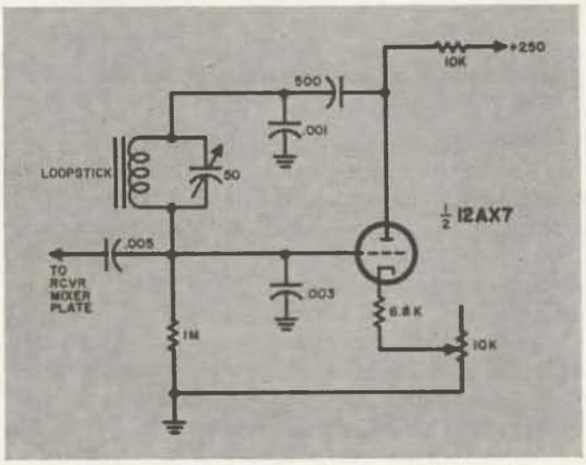

Fig. 7. Basic Q-Multiplier circuit.

453 is the original of this idea, it leaves much to be desired (besides having become nearly unavailable at a reasonable price). Since the basic idea is to convert the 455-kc *if* down to 50 kc or so to take advantage of improved selectivity at the lower *if*, it makes more sense to build a special gadget to do just that, then return the audio to the station receiver for further amplification.

Many such circuits have been published. Some feature crystal control of the second converter, some make use of mechanical, crystal, or L-C filters in addition to the low-*if*

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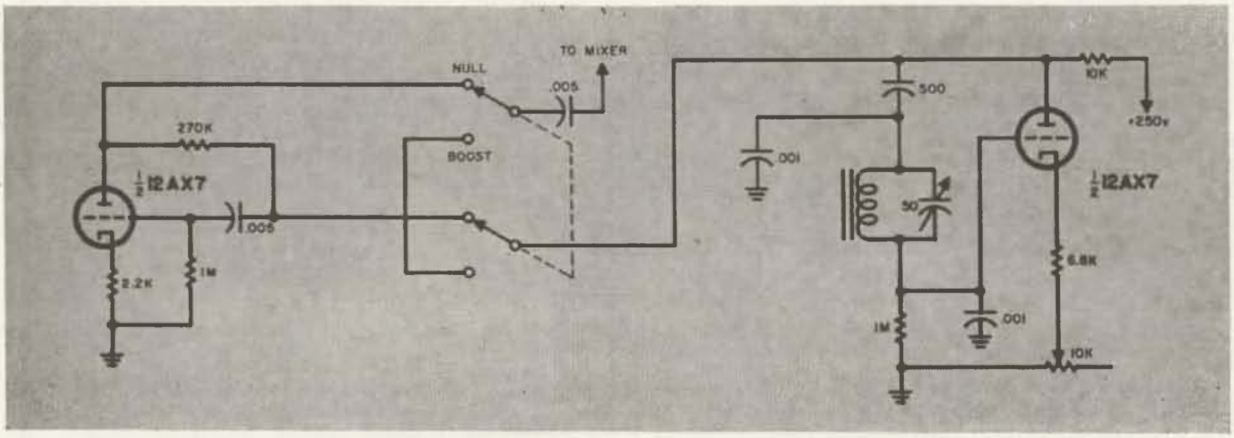


Fig. 8. Complete Q-Multiplier circuit.

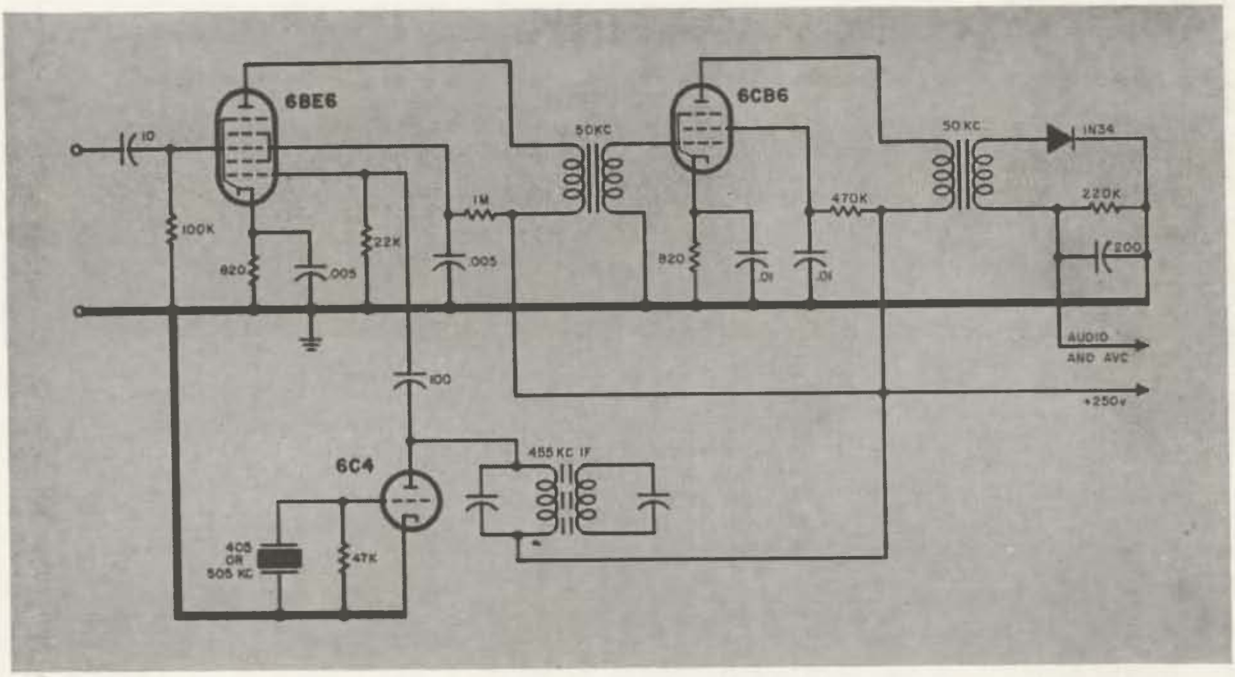


Fig. 10. Q-5er. Input line connects to last *if* grid. Audio goes to the top of the volume control or to the existing detector load resistor if AVC is desired. Crystal frequency will determine which sideband is received. Bandwith is 1800 cps.

selectivity. One of the simplest and most basic "Q-Fiver" circuits is that shown in Fig. 10. It can be built into a small Minibox and connected to the receiver through a pair of short lengths of coax. Though a power supply is shown, required power can usually be stolen from the receiver.

A more-advanced version of the Q-Fiver which allows you to tune the passband across your receiver's *if* bandpass curve is shown in Fig. 11. With this gadget, you'll have a tuning capability offered by only one commercial receiver—the 75A4—and there it's done mechanically instead of electronically. If you add the tunable Q-Fiver, it's best to use the receiver's BFO (readjusted some 50 kc high-

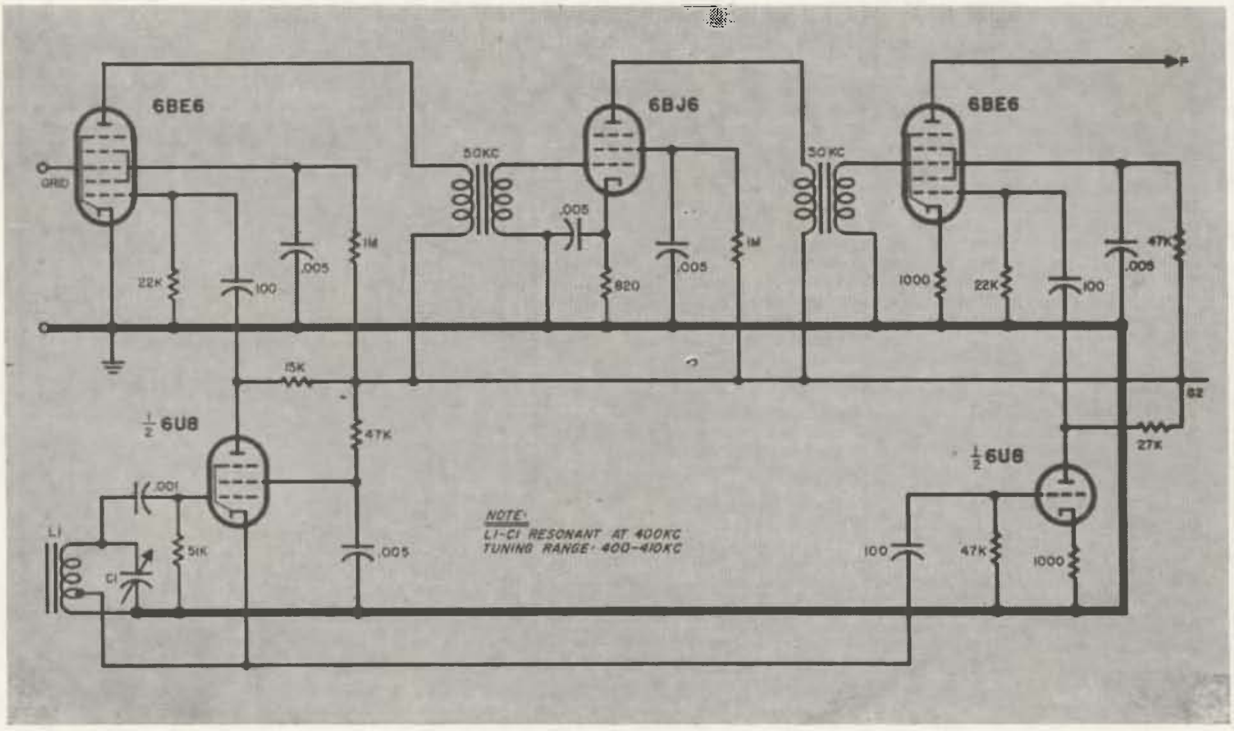


Fig. 11. Tunable bandpass Q-5er. Pentode portion of the 6U8 may be replaced by the receiver bfo to provide front-panel adjustment of the bandpass position. L1 and C1 may be any values which resonate at the *if* frequency 50 kc. All connections are shown with reference to the receiver's last *if* tube socket. Remove *if* tube and substitute Q-5er.

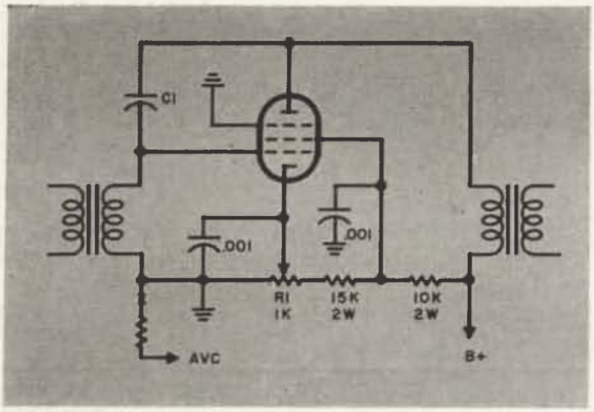


Fig. 9. Simplest Q-Multiplier. AVC line is disconnected at point X. See text for details of C1. Tube is existing *if* amplifier.

er) for the tunable oscillator and substitute a crystal-controlled BFO in the receiver. This will give you complete front-panel control without having to drill any holes in the receiver cabinet, and allow semi-remote placement of the accessory.

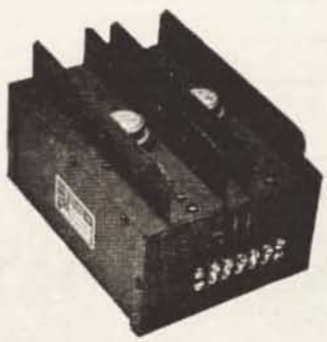
The tunable Q-Fiver works by a triple-conversion process; signals in the *if* range of the receiver are mixed with the tunable oscillator and converted to the second *if*. There, selective L-C circuits trim the passband down to 3 kc. The trimmed *if* is mixed again with the tunable oscillator output and returned to the receiver *if*. From there, the station receiver takes over for detection, AVC, and audio amplification. By varying the frequency of the tunable oscillator, the passband's position in relation to the original receiver bandpass curve can be shifted some 5 kc up or down from center, allowing you to push an interfering station "over the side."

Last stop on this selectivity tour is Slicerville. In the six years or so since the term was coined, the name "signal slicer" has been applied to nearly every type of receiver accessory imaginable. Several Q-Fiver devices have been dubbed "slicers," as have some filter circuits. But strictly speaking, a signal slicer is a phasing-type detector (and as such, almost outside the realm of this roundup).

The slicer operates by dual detection, with phase shift deliberately introduced into the bfo channels. Resulting audio is shifted in phase again, and finally the two audio channels are recombined. Phase relationships are such that signals on one side of the bfo frequency add together, while signals from the other side of the frequency cancel out and can't be heard.

Or in other words, the signal is sliced in half at the bfo frequency. That's where the device got its name. The increase in selectivity is obvious—less than half the original passband gets through the slicer to be amplified.

(Continued on page 50)



Complete construction information on the slicer is too long to incorporate here. It was published in GE Ham News Vol. 6. No. 4 (July, 1951) and will be reprinted in a GE Sideband book set for publication in early 1961. A schematic diagram but no alignment information is on page 15 of "Single Sideband Techniques" by Jack N. Brown, W3SHY.

As mentioned earlier, this short listing doesn't include every selectivity-improving trick in the book. If it attempted to do so, there wouldn't be room for anything else in this issue . . . or in the next, either! However, with the gimmicks collected here, you can easily decide which route or routes you want to follow with your own receiver, in order to be able to pull the signal you want to hear out of the normal QRM. Take your pick!

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W. Orr, **The Radio Handbook**, 15th Edition.

American Radio Relay League, **Single-Sideband Handbook.**

American Radio Relay League, **The Radio Amateur's Handbook.**

Ceramic Filters

A. Lungo and K. W. Henderson, **Application of Piezoelectric Resonators to Modern Band-Pass Amplifiers**, paper presented at 1958 I. R. E. convention, New York City.

Mechanical Filters

Orr, **op. cit.**

L-C Filters

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Q-Multipliers

E. L. Campbell, **Transistorized Q-Multiplier**, QST, January, 1958.

R. L. Ives, **Variable Band Width Q Multiplier**, QST, April, 1957.

J. Kyle, **Improve Your AC-DC Short Wave Receiver**, Popular Electronics, December, 1959.

L. M. Temple, **Q Multiplier, S.S.B., Q-5er and SOJ**, QST, September, 1956.

O. G. Villard, **Flexible Selectivity for Communications Receivers**, Electronics, April, 1952.

Orr, **op. cit.**

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E. P. Alvernaz, **A Novel Side-Band Selector System**, QST, May, 1958.

Orr, **The Radio Handbook**, 14th Edition (omitted from 15th).

Signal Slicers

J. N. Brown, **Single Sideband Techniques.**

GE Ham News, Volume 6, No. 4 (July, 1951, out of print).

"HE WANTS TO KNOW IF WE CAN PATCH HIM INTO ZAMBOANGO!"

(Letters, continued from p. 51)

Grandpa

Dear Wayne,

Reference your January issue, page 6, "A Letter from Mama." Tch, tch, tch! Wayne, I remember hearing W6SGP and I have heard him do the "Grandpa" bit on the air, but his name isn't Cliff Arkett, it's G. W. Richert.

Paul Hudson WA6AVJ

Do you hear that W∅HFK? You're fired.

Greetings OM:

December issue, page 30, fig. 8, pot R1 wiper shorted to ground. Page 33, fig. 1, 12AT7 pin 7 shorted to 8. January issue, page 41, the last paragraph should have read as follows: "Instead of being patterned after a half-wave rectifier, this circuit is an adaptation of the half wave voltage doubler. Since it is a **voltage doubler** device it utilizes both halves of the input signal cycle rather than only one, with the resulting increase in efficiency."

Al Newland W2IHW

Oh pshaw!

W2NSD

Your March cover sure frightened me—I thought you'd moved to another planet! My cell-mate explained it to me: the stone face is a California tool shed which is disguised as an Atlas launching pad; the stone blocks camouflage the air intake for the CD shelter and the little ham shack in the center is a neat ham shack just like the ones we have here in Virginia. I sure feel better now and look forward anxiously to all future copies of 73.

Lynn Wilson W4JXD
Alexandria, Virginia

Cripes!

Club Subscriptions

Quite a few fellows have been clubbing us to announce a cut rate subscription deal. While this is against our basic policy of trying to break even, we must bow to the pressure and start some rustling among the club secretaries. Here's the deal: send us the names, calls and addresses of five or more members at $2.50 per member.. These subscriptions must start with the next published issue.

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The best way to get 73 is by subscription. Fill out form below. How about surprising a friend? Twelve monthly surprises are only $3.00.

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73 Magazine; 1379 East 15th St., Brooklyn 30, N. Y.

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73 Magazine; 1379 East 15th St., Brooklyn 30, N. Y.

Dear Wayne,

To answer your question in regard to MM operation. I see no reason why a passenger could not obtain permission to operate MM. There are some practical considerations. It would be next to impossible on a normal passenger ship due to the antennad needs, however it could be done on a fregihter. You would have to consider the length of the trip, of course. It would be worth while on long trips such as JA, ZS or round-the-world. First you should arrange with the passenger to meet the Master and get his OK. This is a good time to find out if you will have to bring your own ac source. Then you must notify the FCC that you have the Master's permission and give them your itinerary. The antenna will still be a problem, but one good solution is a vertical whip fastened to the rail on the flying bridge . . . coax fed.

Pat Miller KV4CI

Gentlemen:

We would like to have you announce our forthcoming Birminghamest on May 6th and 7th, our Eighth Annual Affair. The main event will be, as usual, at the Alabama State Fairgrounds on Sunday. Wonder if it would be possible for you to come down? **Bill Bankston W4DFE**

Love to Bill, but I'm the guest speaker at the Western New York Hamfest on May 6th in Rochester. The Birminghamfest is one of my favorites, I'll sure try to be there next year.

Dear Wayne,

Congratulations on your editorial in the February issue! At last there is an editor with guts enough to stand out against the liars and the cheats . . . even if it may cost him a subscription or two.

You can imagine how a bridge or poker club would tolerate a card cheat; that is exactly the attitude decent amateurs should exhibit toward the cheats who lie their way into the ranks (but not the spirit) of amateur radio.

If anyone cherishes any Pollyannaish illusions, let him compare FCC figures on the percentage of flunkers on Conditional Class code vs. General Class code or Technician Class theory vs. General Class theory. One would have to be naive indeed to believe that honesty is an attribute of the vast majority of the takers and the givers of "mail order" license examinations. Their integrity stands self-condemned by the utterly incredible number of passing grades.

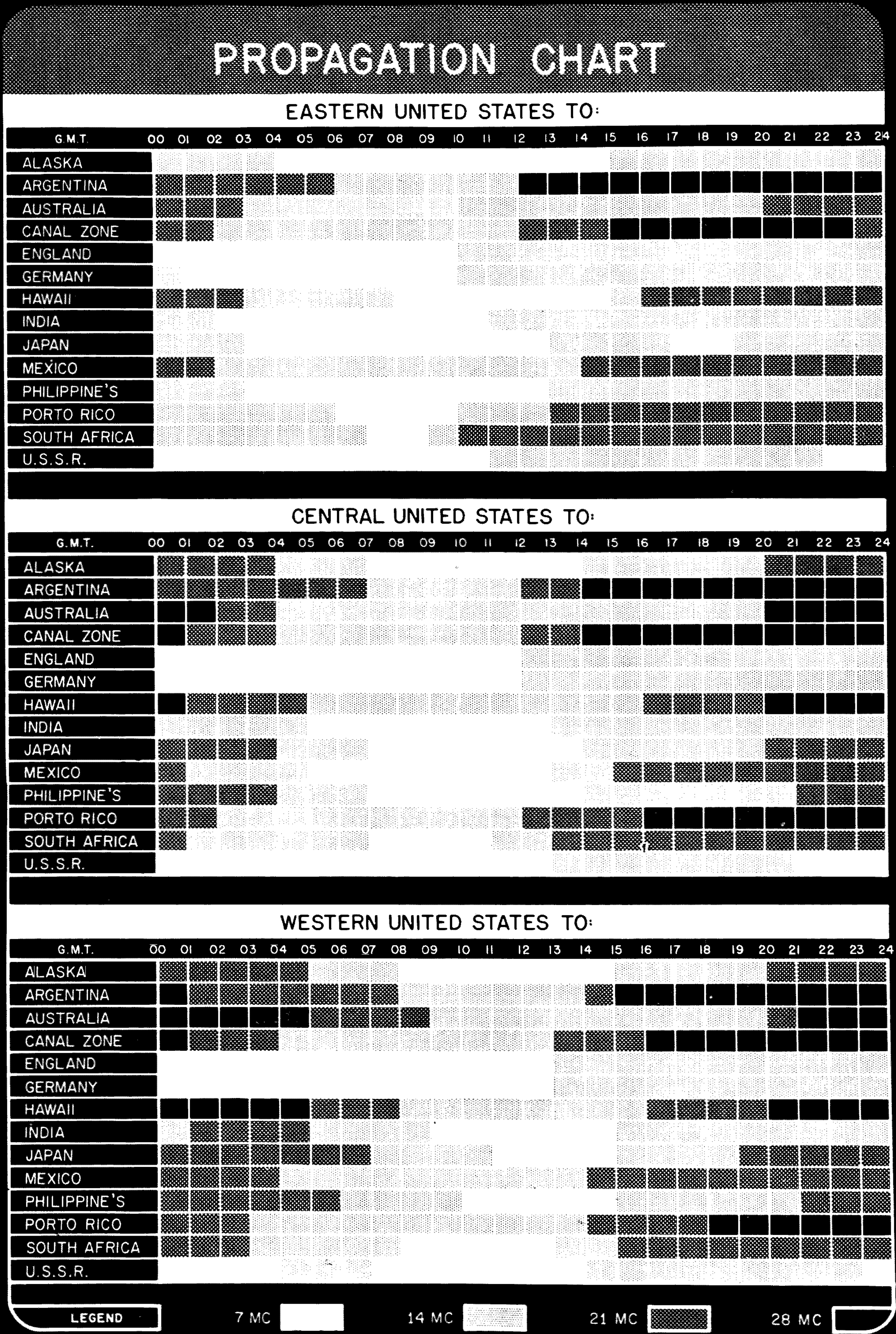
Again, Wayne, congratulations and good luck. It may be that if you keep pounding long enough you can persuade the FCC to return amateur radio to radio amateurs.

Carl C. Drumeller, W5EHC

Dear Wayne,

All my past issues of current ham journals attest to a failing that I would surely like to see you correct with 73. My covers are well marked with notations as to the contents. Now if one put the contents on the cover,

(More on page 55)


PROPAGATION CHART
EASTERN UNITED STATES TO:
CENTRAL UNITED STATES TO:
WESTERN UNITED STATES TO:
G.M.T.
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PORTO RICO
SOUTH AFRICA
U.S.S.R.
LEGEND
7 MC
14 MC
21 MC
28 MC

Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

The bands listed are MUFs and a higher band will not work for the time period listed. Lower bands will work, but not nearly as well. Times are GMT, not local time.

These charts are to be used as a guide to ham load openings for the month of April, 1961 to the various countries listed. I will be interested to hear of your results in using these charts and to know what other areas you might wish included in future charts.

Advanced Forecast: April 1961

Good 1-4, 21-30

Fair 5, 8-10, 18-20

Bad 6-7, 11-17

(Letters from page 53)

similar to the Reader's Digest, it would eliminate the necessity of spending long hours opening covers and looking for some particular idea that is half hidden from the longpast.

L. R. Shackelford K5HSW

Boy oh boy oh boy oh boy oh boy. Here we go to you'll never imagine how much trouble to try to make the cover of each issue of 73 different from anything you've seen before and artistic . . . and what do we get? Rats! Look here, L. R., if you don't mind having magazines with covers like that why not just rip off the front cover and page one of 73 and then you'll have the Table of Contents for your cover. I hope someone appreciates our covers. I had for several years made midget notes on the binding edge of my QST's and CQ's of the more interesting contents. It was only natural then that I should institute this scheme when I became editor of CQ. Since 73 will not be having this binding edge due to the saddle stitch binding we are using, this system is not practical. I believe that the convenience of being able to lay your magazine flat on the table is of more importance than having an edge stick out of the bookshelf for you to read . . . particularly since we have so very many construction articles.

Dear Wayne,

The Fiat 500 isn't much of a sports car, but you might be able to direct me to someone who has cleaned the 2 meter ignition noise out of one. I've got one of the little monsters, with a Gonset and a Hi-Gain whip, which is fine when the motor's off, but an ear-basher in motion. (That Gonset is getting a Lamb-circuit nuvistor preamp shortly.) The ignition leads are pretty close to ½ wave, which improves the strength considerably. I've got an improvement over the Gonset transmitter in process, push-to-talk and 10 watts out, which you might think was worth making an article out of. Sound off if you're interested.

Keep up the good work. You've got the right idea.

Joel S. Look W1KCR

Yes, send the Gonset conversion. Check waiting. Does anyone have any suggestions for killing the noise in his "500"?

How to Write for 73

Jim Kyle

HAVE you designed or built an original item of equipment? Would you like to have cash in pocket to pay for it? Or prestige among your buddies? Then write it up for 73.

The only way in which we can continue to offer more construction articles per issue than any other ham magazine is for you, dear reader, to describe your design and construction efforts. To encourage you in this endeavor, we pay legal tender for your words. But to make certain that you accomplish what you set out to do, here are some hints on how to write for 73.

The best guide to the type of article, we want, naturally, is the group of articles published in each issue. However, don't carry this to extremes. After we have three articles on the same type of equipment, we'd sort of like to concentrate on other areas for a few issues. But careful study of the published articles with attention to their organization, wording, and approach will pay dividends.

Hamming is a hobby, not a business (though many BFs would question this statement), and your article should read interestingly rather than like a business report. In general, try to describe the equipment as if you were telling your buddy down the block how to build it—for in essence, that's what you're doing.

So far as organization of the article goes, a good rule is to tell your story three times—or in the words of an excellent back-country orator, "First I tells them what I'se going to say, then I says it, and then I tells them what I said."

By this, we mean to give a summary of the entire article in the first couple of paragraphs. This lets the eventual reader know if he's going to be interested in it or not. Then go into the detail. Finally, sum it up briefly at the end.

Speaking of detail, be sure not to leave it out. Not too long ago, one writer (a staff member at that) wrote a long antenna piece—and after doing so, discovered that nowhere in the article did he give any dimensions or tell how to build the skywire! Luckily, this error was caught in time—if it hadn't been, the mailmen would have been deluged (if the article had seen print in such shape).

Include all calibration and adjustment instructions where necessary. This can make the difference between good results and none at all for the guy who duplicates your effort. Along the same line, include a complete parts list, with manufacturer's type number of each part if available.

Remember, always, that you're writing for other hams. This means that acceptable abbreviations and idioms which will be known to every one are acceptable. On the other hand, it's no excuse to be cute with excessive use of Q signals and such (73 is printed, not telegraphed to its subscribers). If your article includes technical discussions, watch the level. Don't explain Ohm's Law in one-syllable words, but on the other hand don't take for granted a detailed knowledge of radar-scattering principles either. Let common sense be your guide here.

Now, let's look at the mechanical details of your article. First, it should be typed—preferably with a typewriter, not a Model 26. The manuscript should be double-spaced, on white unruled paper. Keep a carbon of it, but submit the original. The reason for this is that the carbon tends to smudge during editing, and becomes difficult for the printer to read.

Include your name and address on each page of the article, preferably near the top. This lets us put it back together should a gust of wind mix it up with others. For the same reason, pages should be numbered consecutively.

With the article complete, you're only half done. Illustrations are a must.

At the very least, a schematic is necessary. If chassis layout is critical or important, a sketch of this is needed too. All such line art can be submitted as neat sketches, since it will be redrawn to 73 style by our draftsman. The key point is to make sure that the sketch is not subject to misreading because of crowded lines.

Last but not least are photographs. While we can and sometimes do print construction articles without photos, we prefer that pictures accompany the article.

For one thing, a good photo makes more people want to build the item. For another, it's proof to the unbeliever that the equipment was actually built. And finally, a clear photo will show many details which can never be

shown on drawings or explained in text.

Photos must be sharp, clear, and well-lighted. If photography isn't one of your other hobbies, the best bet is to locate a friend who knows it well and enlist his help. We prefer that prints be 8 x 10 glossies, but good 5 x 7 prints are usable, as are prints on *smooth* semi-gloss paper.

Technically, you should either "paint with light" or use bounce-lighting in making equipment photos. Cameras smaller than 6 x 6 CM negative size seldom give acceptable results. And if this paragraph leaves you cold, find a friend as advised earlier. (Maybe later we'll have an article on the taking of equipment photos. Want one?)

With all things accomplished, you're ready to send your manuscript in. Write a short note explaining what it is, enclose return postage if you want it back in case of rejection (unhappy thought—but it sometimes happens) and mail it in. Before very long (the exact time varies with the other activity in the office) you'll either get a check of a rejection slip. If you've followed the advice given here, it will most likely be the former.

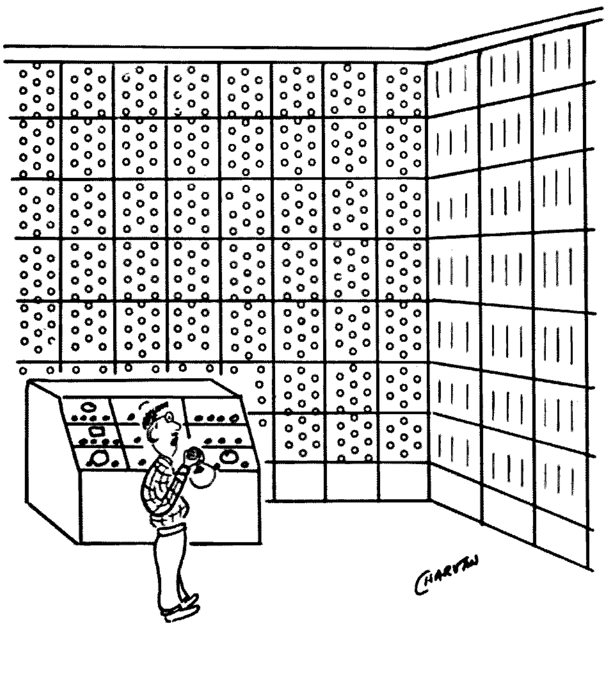
(Automation from page 29)

doubletalk, the circuit can be bypassed by a switch. Be extremely careful to locate the switch properly. Incorrect positioning in the circuit could destroy much of the transmitter.

Having described a spiral of ever-decreasing radius, we are now ready to start over at the microphone. Note that it feeds a three-way splitter. This consists of three triodes whose grids and cathodes are in parallel, but whose plates feed three separate outputs. One output goes to the transmitter itself, one to the vox unit (together with standard anti-trip signals from the receiver) and the third to the Tape Log Unit.

Since the microphone is on at all times in the Log circuits, a permanent and complete log is maintained. Exact time of every word you speak can be determined by comparison with the WWV signal recorded at lower level on the same tape. While not checked out with the FCC, there appears to be no reason why this log could not be used instead of a written document. (If the Radio Inspector rules otherwise, you can always hire a stenographer to transcribe it for you.)

That's it—the whole incomprehensible mess. With care, it could be built in a standard six-foot relay-rack cabinet for something less than $1,568 (if judicious selections are made from surplus). That's why it's never been built here, and probably won't be in the near future. But if you have a pair of oil wells in the back yard, and don't mind a little tinkering, you too can have a completely automated station (and with a little more engineering, it can be made to operate itself, freeing you from the drudgery of contests and the like and leaving you free to read. . . . 73



"I got on the air alright Max, but now I can't turn it off."

AIR FORCE MARS
Technical Broadcasts

Very interesting talks given each Sunday from 2-4 p.m. (EST) on 3295-7540-15715 kc.

April 2—No broadcast today.

April 9—Capt. John D. Griffiths: Theory of Speech Communications.

April 16—Capt. John D. Griffiths: Modern Techniques in Speech Communications.

April 23—Phillip E. Hatfield: Basic Electronics for the Radio Amateur.

April 30—Edward A. Neal: Custom Building via Home Construction.

May 7—Warren Bonney: Telecetry: Its Purpose, Its Function.

(Indians from page 26)

Makes him think, anyhow. Tell him you actually gave your phone number over the air and *asked* for interference reports (if you did—remember he hears your transmissions!) Tell him how you checked various neighbors and they said "No interference" . . . mentioning makes of sets and approximate age if you can.

And another redskin bites the dust! Now for number seven.

"My neighbor says. . . ." or his wife's Uncle Louie . . . or the man who checks his wife out at the Supermarket . . . or any other competent and qualified expert.

Here's where the FCC is a real friend! Tell your neighbor that you don't doubt that he has been told thus and so for a minute, BUT . . . and cite the *published statement* of the FCC that about 95% of ALL TVI complaints they have investigated turned out to be due to receiver mal-function (W. L. Kiser, Chief Engineer, FCC New York among others have publicized this fact.) Then you can lead into the filter story and take it from there.

Two more little indians always come in pairs. *"I'll have the FCC run you off the air"* and *"I'll speak to my brother whose on the City Council and have you put out of business."*

If you get this pair, roll with the punch—

(Now turn the page)

Fresno Hamfest May 6th

Registration at 8 am, Towne & Country Lodge in Fresno. Technical talks, demonstrations, swap table, mobile field intensity measurements, hidden transmitter hints, ladies luncheon and special entertainment. The banquet at 7 pm is included in the $5.50 registration fee. Reservations: Box 783, Fresno, California.

(TVI from page 59)

and don't argue. Just give the neighbor the address of the FCC and *relax.* After all, you *know* your rig is clean (you'd better!) and the FCC is on your side . . . so long as you are only cutting up one or two TV sets in the neighborhood and the rest are not bothered. Rip 'em all up, and you're in for trouble with the FCC inspectors.

If the Councilman is a lawyer, he knows better than to try to step into an area that belongs to the Federal Government . . . the regulation of radio activities is *constitutionally* in the hands of Uncle Sam. So relax. Even if the local legal beagle politician does make big noises, the law's on your side. A man's house is still his castle, and what you do in it is your right—so long as it's legal, not a commercial use of residential property, and doesn't interfere with health or morals, the local politician will have a mint of trouble getting you off the air.

Last but by no means least—and sometimes the Big Chief of all Indians—is the really mad individual that won't even talk to you at all. There's only one thing to do here. First of all, have another ham phone him and offer his services to clear up the complaint. It may work. But even if it doesn't, just be *sure* your equipment is operated properly at all times. Check and check again around the neighborhood to be sure you aren't interfering with others. The more careful you are to do this, the more apt, our friend Mr. Madguy is to hear about it—and realize in spite of himself that you really are interested in clearing up TVI. You may not ever win him over, but at least you can throw your rig on the air with a clear conscience!

One last word—no matter how obstreperous your own particular Mr. Madguy may be, *keep your sense of humor and your temper*—even if, as some hams have, you run into problems of cut lead-ins. In the long run, it'll pay off. 73

(Nuvistors from page 11)

tivity this can be a problem. If you do get cross modulation reduce the rf gain control just to the point you stop hearing the interfering station. If you live in a neighborhood of strong stations this converter isn't for you but if you are interested in copying some of those weak stations you haven't been able to pull in it may do a good job for you.

We are currently experimenting with front end circuits to reduce cross modulation problems and if we come up with anything real good we'll pass it along later.

Many thanks to Chuck Kuespert, K9JKG for his many hours spent in helping develop this converter, and wiring dozens of circuits, and many complete converters to try to make a converter that is hot and bug free.

. . . K8BYN

Advertisers Index

Alden 45
Alltronics-Howard 63
Arrow Electronics, Inc. 64
Barker & Williamson 51
Barry 53
Call-D-Cal 63
Candee 62
Centimeg 49
Central Electronics 1
Clark 43
Clegg 2
Columbia 47
Cushcraft 45
Editors & Engineers 41
EICO 8
E-Z Way Towers 6
Fair Radio 57
Globe Industries 49
Gonset ..... Cover II
Graham 45
Heath 39
Hi-Par 57
International Crystal 5
KTV Towers 57
Lafayette Radio 7
Lektron 61
L-W Electronics 51
Maps 51
Mercury 43
National ..... Cover IV
Neil 47
Petersen ..... Cover III
P & H 43
Radio Bookshop 60
Reyco 57
Rex 45
Rider 58
RTTA 63
Shorecrest 63
Stellar 59
Subscriptions 52
Tapetone 61
Technical Material Corp. 41
Telrex 50
Texas Crystals 55
U.S. #1 Electronics 53
Vanguard Electronics 59
VHF-UHF Associates 52
Western Radio (San Diego) 59
Western Radio (Nebraska) 61
World Radio Labs 37

Other Ham Publications

In lieu of half of the magazine being filled with specialized departments, we recommend that you subscribe to the bulletin of your special interest. You get a lot more news and get it faster this way . . . and you encourage the fellows who are putting out these bulletins.

WESTERN RADIO AMATEUR. Don Williamson W6JRE, 10517 Haverly Street, El Monte, California. Monthly. Subs are $2 per year, $3.50 for two years, $5 for three years. Operating news of west coast activity, columns on DX, SSB, YL, and some articles. 48 pages

MOBILE NEWS. Published monthly by the Amateur Radio Mobile Society, 79 Murchison Rd., Leyton, E. 10, England. Joining fee and 1 year sub. is $2.50.

73 HAM CLUB BULLETIN. Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Sent free to all editors of ham club bulletins monthly to keep them abreast of what is going on with all the other ham clubs. This is an excellent source of news for putting together your club bulletins. To subscribe to this news bulletin just send a copy of your own club bulletin to Marvin.

HAM-SWAP. Published by Ham-Swap, Inc., 35 East Wacker Drive, Chicago 1, Illinois. Editor is Ed Shuey, K9BDK. Subs are $1 per year by 3rd class mail, $3 for 1st class, $5 airmail, and $7.20 special delivery. Published once a month. Contains classified ads entirely. This is your best bet for an inexpensive way to sell or swap some gear in a hurry. Within two weeks people are answering your ad.

DX BULLETIN. Don Chesser W4KVX, RFD 1, Burlington, Kentucky. DX news in depth. Published weekly. 3rd Class mail $5 year; 1st class $6; Airmail $7.50. DX rates on request.

HAM-HOP NEWS. Published quarterly by the International Ham-Hop Club, G. A. Partridge G3CED, 17 Ethel Road, Broadstairs, Kent, England. 75¢ per year for bulletin, $1.50 full membership. Club devoted to arranging visits between hams and ham families all over the world.

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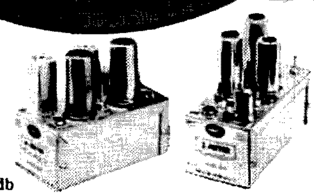
ZIMCO THEFT ALARM

Protect your radio gear in cars, boats and trucks with Zimco's burglar proof siren alarm. Unit consists of tamper proof siren and latching relay, key-operated on/off switch and 6 push button alarm switches. See QST Jan. '61, page 27.

Complete kit, 12 VDC 59[95]

6, 24, 32 VDC & 115 VAC models available on special order.

AMECO 2 & 6 METER CONVERTERS



Crystal Controlled
Gain: over 30 db
Noise Figure: better than 4 db

Tube Lineup: 2 meter Converter has new, imported 6ES8 high gain, low noise, cascode 1st RF Amp., 6U8A 2nd RF Amp. & Mixer, 6J6 Osc.—Multiplier.

6 meter Converter has 6BS8 Cascode RF Amp and 6U8A Mixer and Osc.

	6 meter	2 meter
Converter complete with tubes and xtal for 7-11 or 14-18 mc. IF output in	CB-6	CB-2
Kit form with instructions	$19.95	$23.95
Wired and tested	$27.50	$33.95

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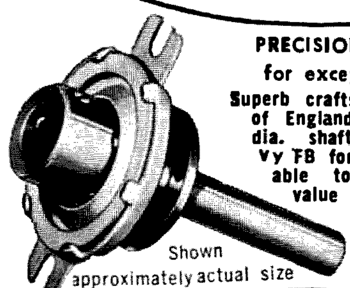
for exceptionally fine tuning



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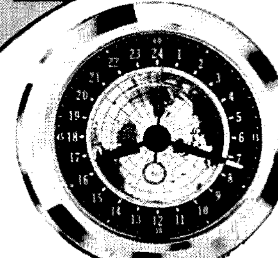
10 for $13.50

Shown approximately actual size

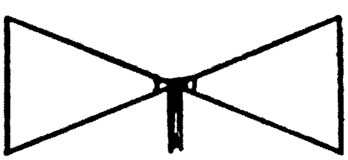
24 HOUR CLOCK



24 hr. chrome plated 8" metal wall clock. Inner dial with south polar projection map of world indicates time around world. Polar projection dial adjustable for various time zones. Shpg. wt. 2 lbs.

Amateur net $8.47
tax inc.

220V. 50 cycle model............9.95

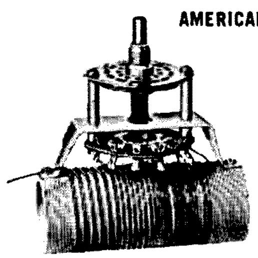


"Wonder Bar" 10 Meter Antenna

As featured in Nov. 1956 QST. Complete with B & W 3013 Miniductor. Only 8 ft. long for 10 meters. Wt. 5 lbs.

Amateur Net $7.85

AMERICAN GELOSO PI TUNING COILS

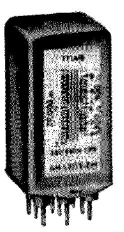


Units have 6 posit. tap switch mounted on ceramic coil form. Mod. 4/111 designed for use with two 807's or 6146's (in parallel). Freq. Range 3.5 to 29.7 mc.

Mod. 4/112 is designed for use with single 807 or 6146. Handles up to 60 w. Range: 3.5 to 29.7 mc.

Mod. 4/111 or 4/112, each $4.95

Versatile Miniature Transformer



Same as used in W2EWL SSB Rig — March 1956 QST. Three sets of CT windings for a combination of impedances: 600 ohms, 5200 ohms, 22000 ohms. (By using center-taps the impedances are quartered.) The ideal transformer for a SSB transmitter. Other uses: interstage, transistor, high impedance choke, line to grid or plate, etc. Size only 2" h. x 3/4" w. x 3/4" d. New and fully shielded.

Amateur Net $1.39

3 for $3.49 10 for $10.75

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SAY YOU SAW IT IN 73

with built-in PRODUCT DETECTOR

NC 270

THE "COSMIC BLUE" NATIONAL'S NEW HAMBAND RECEIVER

This newest and finest precision double conversion amateur receiver with 6 meter coverage, brings you an ease of sideband tuning previously available only in the most expensive equipment. The NC-270 features an exclusive "Ferrite Filter" for instant upper-lower SSB selection and a degree of selectivity to conquer even the toughest AM and CW signal conditions. The solid 1/8" steel panel, ceramic coil forms, double-spaced tuning gang, and full ventilation cabinet combine to give mechanical and thermal stability that will surprise even the most critical operator. Even the color of the NC-270 is outstandingly different, National's new duo-tone "Cosmic Blue." Write for detailed specifications.

Only $24.99 down*

And National Radio's patented "Flip Foot" makes operating the NC-270 so easy.

Suggested cash price: $249.95. NTS-3 Matching Speaker. $19.95 (slightly higher west of the Rockies and outside the U.S.A.). *Most National distributors offer budget terms and trade-in allowances.

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73 Amateur Radio

May 1961

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RF LINEAR AMPLIFIER

BIG... with a **husky**, go-places power rating of **1500 watts PEP**...

SMALL... only a foot across the front—**less than one-and-a-half feet in depth!** No space problem here—these are true "table-top" dimensions.

Fine looking—modern industrial designer styling—finished in durable, attractive light colors. Blends well with existing equipment.

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Full bandswitching 80-40-20-15 and 10 meters • pi network output • stable, efficient grounded grid circuitry • Power input rating: 1500 watts PEP SSB • 1000 watts CW • 400 watts AM • can be driven by exciters in the 65-150 watt category, GSB-100 and similar units • Low cost Type 811A tubes used in amplifier • long life silicon rectifiers replace older vacuum tube rectifiers in high voltage power supply • Antenna changeover relay is built in • panel switch allows tune up at low power • full vision panel instrument is switchable to indicate amplifier plate current or relative RF output • Dimensions, 8½" high, 12⅝" wide, 17" deep.

Model #3340

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EXPORT SALES: WESTREX CORP., 540 WEST 58TH ST. NEW YORK 19, N. Y.

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ZEUS

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Again . . .

Clegg Laboratories brings VHF'ers a new power packed performer . . . A new beauty that's guaranteed to produce more carrier output and a higher level of modulation power than any other commercially built VHF amateur transmitter now available.

Put a *Zeus* on 6 and 2 and watch the QSO's roll in. If you like DX, listen to this! — You'll have 185 solid watts on *both* AM and CW . . . and you'll have *automatic* modulation control that will actually let you "out-talk" many kilowatt rigs!

CHECK THESE FEATURES AND SEE WHY A NEW ZEUS WILL PUT YOUR CALL ON THE "MOST WANTED LIST"

- **High Level Plate and Screen Modulation**
- **Highly Efficient Type 7034 Final Amplifier**
- **Self-Contained Stable VFO**
- **Built-In Automatic Modulation Control**
- **Simple Band Switching and Tune-Up**
- **Two Unit Construction with Remote Modulator and Power Supply Conserves Space at Operating Position**

Amateur Net Price: Only $595. Completely wired and tested with all tubes, Modulator, Power Supply, VFO, cables, etc.

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Ask your Clegg Distributor (listed below) for full information. He'll be glad to serve you.

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Connecticut
Kaufman Electronics, Bridgeport
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Delaware Electronics Sup., Wilmington
Florida
Amateur Radio Center, Inc., Miami
Electronic Equipment Company, Inc., Miami
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Brown Distributors, Fort Wayne
Van Sickle Radio Supply, Indianapolis
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World Radio, Council Bluffs
Kansas
Acme Radio & T. V., Hutchinson

Maryland
Key Electronics, Wheaton
Massachusetts
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Purchase Radio Supply, Ann Arbor
Radio Parts, Inc., Grand Rapids
Missouri
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Walter Ashe, St. Louis
New Mexico
Car Parts Depot, Roswell
Valley Engineering, Los Alamos
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Federated Purchaser, Mountainside
New York
Terminal Electronics, New York
Harrison Radio Corp., New York

Ohio
Universal Service, Columbus
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Pennsylvania
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Eugene G. Wile, Philadelphia
South Carolina
Dixie Radio Supply Company, Sumter
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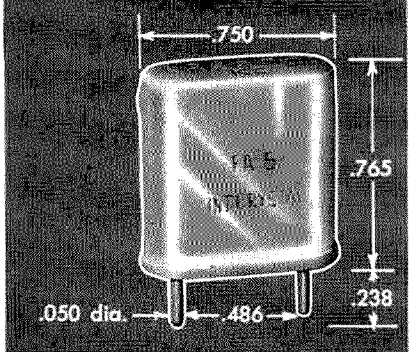
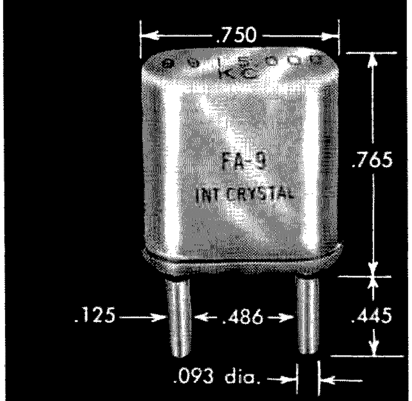
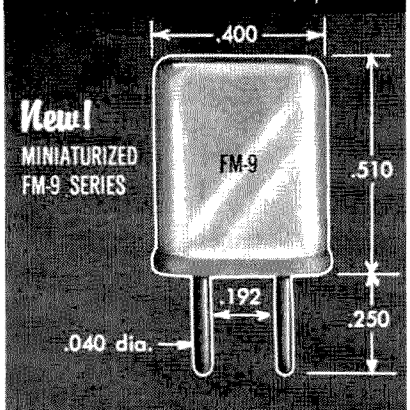
Amateur Crystals

1000 KC to 137 MC - .01% TOLERANCE







New! MINIATURIZED FM-9 SERIES

Wire mounted, plated crystals for use by amateurs and experimenters where tolerances of .01% are permissible and wide-range temperatures are not encountered.

Just any crystal in any oscillator will NOT combine to produce spot frequencies. These crystals are designed to operate into a 32 mmf load on their fundamental between 1000 kc and 15000 kc. Overtone crystals operate at anti-resonance on 3rd mode and series resonance on 5th and 7th mode crystals.

- **HOLDERS:** Metal, hermetically sealed. FA-5 and FA-9 are HC/6U pin type while the FM-9 is an HC/18U pin type.
- **FREQUENCIES** (Specify crystal type and frequency when ordering.)

	FA-5 and FA-9	Price	FM-9	Price
Fundamental	1000 - 1499 kc	$ 5.75	Not available	
	1500 - 1799 kc	$ 4.95	Not available	
	1800 - 1999 kc	$ 4.40	Not available	
	2000 - 9999 kc	$ 3.30	8000 - 9999.999 kc	$ 5.00
	10000 - 14999 kc	$ 4.40	10000 - 15000 kc	$ 5.50
	15000 - 20000 kc	$ 5.50	15001 - 19999.999 kc	$ 6.50
Overtone (3rd)	10 - 14.99 mc	$ 4.40	Not available	
	15 - 29.99 mc	$ 3.30	20 - 39.99 mc	$ 5.00
	30 - 59.99 mc	$ 4.40	40 - 59.99 mc	$ 5.50
Overtone (5th)	60 - 75.99 mc	$ 4.95	60 - 89.99 mc	$ 6.50
	76 - 99.99 mc	$ 7.15	90 - 100 mc	$ 8.50
	Not available		101 - 110 mc	$10.00
Overtone (7th)	100 - 137 mc	$ 9.35	Not available	

Overtone crystals are calibrated on their overtone frequency. They are valuable for receiver-converter applications and are NORMALLY NOT UTILIZED IN TRANSMITTERS, since only a small amount of power is available under stable operating conditions.

- **CALIBRATION TOLERANCE:** ± .01% of nominal at 30° C.
- **TEMPERATURE RANGE:** —40° to + 70° C. ± .01% of frequency at 30° C.
- **DRIVE LEVEL:** Recommended, maximum 3 milliwatts for overtones; up to 80 milliwatts for fundamentals, depending on frequency.

ONE DAY PROCESSING . . .

Orders for less than five crystals will be processed and shipped in one day. Orders received on Monday through Thursdays will be shipped on the day following. Orders received on Friday will be shipped the following Monday.

WRITE FOR 1961 CATALOG FREE!

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73 Magazine
1379 East 15th Street
Brooklyn 30, N. Y.

May 1961
Vol. 1, No. 8

Table of Contents

G4 Zed Smith .... Hartland Smith W8VVD 9
A tri-bander without loading coils or traps; can be tuned from the shack!
Feedline Economy .... William Roberts W9HOV 18
Open-wire line just may become popular again after you read this one.
Propagation Special Feature .... Dave Brown K2IGY 20
Taking a look at sunspot numbers with an eye to predicitions.
Testing the KT-200 Receiver .... Allie C. Peed K2DHA 22
Next month we have some of Bill Orr's ideas for modifying this receiver.
Ham Calendar .... R. M. Case K4YNO 25
Just what we've been needing. Should go nicely with a 35 hour clock.
Build a Vary-Volt .... Joseph Leeb W2WYM 26
A piece of test equipment that is worth its weight in something or other.
Moonstruck .... Dave Bell W8GUE/6 28
Eyewitness account.
Moon Chart .... Bill Ashby K2TKN 31
How to get radio signals back from the moon, reduced to a chart.
Sideband Exciter .... Angel Fernandez W2NQS 32
What with Turret construction and a simple circuit you may try this one.
Testing the Knight GDO .... Steve Abrams W2OKU 35
Porsche-pushing ham tests Knight GDO, likes it, tells all.
Propagation Charts .... Dave Brown K2IGY 36
What time to where, when on what bands . . . probably.
Custom Resistors .... Roy E. Pafenberg 38
How to move precision resistors to the value you need.
AC Calibration of your VOM .... William Bentley 40
We'll be giving you more and more on precision and calibration.
Ohms by the Yard .... Jim Kyle K5JKX/6 41
This ties in with the precision resistors on page 38.
Blowers .... Melvin Leibowitz W3KET 42
What size blower you need to keep a cool rig.
How Low The Fi .... Staff 44
Our technical article: examining the audio stages of your receiver.

Misc.:

Table of Contents 3
Editorial 4
Subscription Rates 6
High Voltage Insulation for Meters 21
Club Subscriptions 30
Quick and Cheap 37
Improved Meter Accuracy 49
Letters 51
Maps Maps Maps Maps Maps Maps Maps 52
Ham Headlines 55
AF MARS Technical Broadcasts 55
Public Information Field Day 56
$65 Sideband Transceiver 57
Other Ham Publications 59
Advertising Index 62

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. . . de W2NSD

(never say die)

More Congratulations

Are in order. You fellows are without a doubt the liveliest group of magazine readers ever assembled. You've not only been brainwashing our advertisers with information requests, but you've been sending them checks with abandon. It is quite a pleasure for me, as chief advertising salesman, to call advertisers and find that I don't have to suggest that maybe next month things will pick up a bit. When I call they sell *me*. They must be exaggerating a bit when they say that they're getting as good results from advertising in 73 as they do from magazines with twice or three times the circulation. I like to hear it, but I don't really believe it. You aren't working *that* hard, are you?

The post card we bound in the last issue gave me some weary nights clipping all those information requests out and sorting them for the advertisers. It also gave me some terrifically effective ammunition for shooting down some of the more reluctant prospective advertisers. There are still some well known ham manufacturers conspicuous by their absence as supporters of the magazine. A few of the readers, noticing this absence, requested information from missing advertisers. This is probably a much better advertising sales talk than the one that I have been using, which draws more on their heartstrings than their business acumen.

Three in One

The Totah ARC of Farmington, N.M. have discovered an unusual spot for a DXpedition. Look for 'em on the bands on May 27-28 operating from the junction of the W5-W7-Wø call areas, which is also the meeting point for four states. Your QSL will bring you a colorful certificate.

Too Many Ads

We really should have put in a few more pages this month, but we're still trying to work our way out of the difficulties and expense of moving our office to new larger (and just as ugly) quarters. So bear with us for a little longer as we try to get this thing on an even keel. We've got a lot of interesting stuff in preparation for you. Two meter ops will be pretty excited over the new mobile (and fixed station) antenna we've got coming. This one seems to have a lot of advantages over the halo. Sidebanders will like our coming transceiver. Then we have a 2M transceiver too . . . and it can mostly be built from junk parts from old TV sets or FM sets. Plus all sorts of small projects.

FCC Actions

The Maritime Mobile Amateur Radio Club has petitioned the FCC for a very long overdue modification of the regulations to permit MM stations to use 20 meters world-wide and also 40 meters while in North and South American waters. This is particularly important in view of the rapidly deteriorating band conditions which are leaving the ten and fifteen meter bands high and dry and about as useful as two meters. Let's hope that this proposal goes right through without the usual three year battle.

Phoenix May 26-29

Virginia and I are looking forward to meeting as many of you as possible at the big Klatch in Phoenix this month. This will be a combination subscription gathering expedition and honeymoon for us . . . in case you missed the not too cryptic note on page three last month. If you're within driving or flying distance this extended weekend shindig will make a fine vacation for you.

In addition to lots of equipment displays you will get a chance to hear Senator Barry Goldwater (ex 6BPI), Bill Orr W6SAI, Leo Earnshaw ZL2AAX, Don Stoner W6TNS, Wes Schum W9DYV, Merrill Swan W6AEE, and other interesting speakers.

Drop a line quickly to K7AWI, Box 7155, Phoenix, Arizona for all the details, or else show up on the 26th and join the fun. It's at the Westward Ho Hotel. And wow do they have prizes lined up for you!

Wise Words for Weary Writers

No matter what the Boy in the Back Room says, $20 in the hand is worth a lot more than $40 in the bush. When you submit an article to 73 you either get it back or you get a check . . . and with no one, two or three year wait.

To the hundreds of Hams who have taken the time to write, we at EICO can only say...

FROM THE BOTTOM OF OUR HEARTS, THANK YOU

We promise to continue to do all in our power to merit your approval.

Milton Stanley
3909 High View Rd.
E. Peoria, Illinois

Electronic Instrument Co., Inc.
3300 Northern Blvd.
Long Island City 1, N. Y.

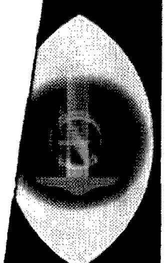
Dear Sir:

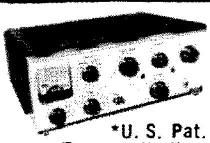
When I saw your Model 720 Transmitter on display, it looked so good that I decided to purchase a 720 kit. I put it together in five evenings. The instruction book is so well written that any beginner can build this kit with no trouble at all. When I put the 720 on the air for the first time, I called CQ and a station in Munising, Mich. answered me and gave me a 599 report. In two months I had worked 37 states with a single wire antenna about fifteen feet off the ground. All stations worked gave me a good report. I was so pleased that I purchased an EICO Model 730 Modulator. Results were equally good. I have worked 44 states and Canada on phone with the 720 and 730. All reports I get are very good. The clipping level control and the over modulation indicator helps make the EICO 730 Modulator the best buy for the money and I personally believe the EICO 720 Transmitter is the best 90-watt rig on the market. The EICO 720 and 730 together make an all around rig that is hard to beat. I am so well pleased with the quality of EICO kits that I am looking forward to building more of your products. I highly recommend EICO kits to beginners as well as the old timers.

Sincerely,

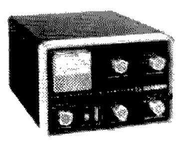
Milton Stanley

MILTON STANLEY, K9VJH

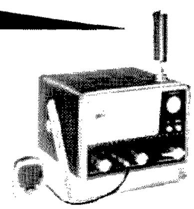




90-WATT CW TRANSMITTER* #720
Kit $79.95
Wired $119.95
*U. S. Pat. No. D-184,776
"Top quality" — ELECTRONIC KITS GUIDE. Ideal for veteran or novice. 90W CW, 65W external plate modulation. 80 through 10 meters.



NEW! 60-WATT CW TRANSMITTER #723
Kit $49.95
Wired $79.95
Ideal for novice or advanced ham needing low-power, stand-by rig. 60W CW, 50W external plate modulation. 80 through 10 meters.



CITIZENS BAND TRANSCEIVERS
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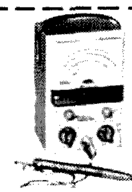
From Kit $59.95 Wired $89.95

HIGH-LEVEL UNIVERSAL MODULATOR-DRIVER #730
Kit $49.95 Wired $79.95
Delivers 50W undistorted audio. Modulates transmitters having RF inputs up to 100W. Unique over-modulation indicator. Cover E-5 $4.50.

GRID DIP METER #710
Kit $29.95 Wired $49.95
Includes complete set of coils for full band coverage. Continuous coverage 400 kc to 250 mc. 500 ua meter.



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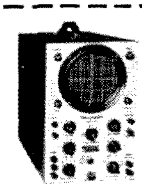
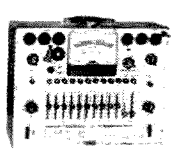
Kit $25.95 Wired $39.95

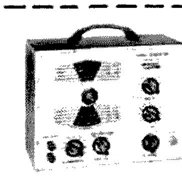
*U. S. Pat. No. 2,790,051



COLOR & MONO DC-5MC LAB & TV 5" OSCILLOSCOPE #460
Wired $129.50
Kit $79.95
5" PUSH-PULL OSCILLOSCOPE #425 Kit $44.95 Wired $79.95



DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666
Kit $69.95 Wired $109.95
TUBE TESTER #625
Kit $34.95 Wired $49.95



RF SIGNAL GENERATOR #324 (150kc-435mc)
Kit $26.95
Wired $39.95
TV-FM SWEEP GENERATOR & MARKER #368
Kit $69.95 Wired $119.95

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Add 5% in the West.

ENGINEERS: Excellent career opportunities in creative electronics design. Write to the Chief Engineer.

(Editorial from page 4)

It is not even necessary to produce two doctors and one minister as evidence that you need immediate remuneration. Our Handy Guide on How To Sneak Things By The Editor is available at the bargain price of free if you send a self-addressed stamped (we're not only lazy, we're cheap) envelope. Mark it "Style Sheet" so you won't be flooded with ditto printed trivia from the editor as promised back in March.

Feedback

Doggone if you all didn't surprise me this time. We had so many articles in the March issue that the votes were rather more scattered than usual. It was, however, nip and tuck all the way along between the Transistorized GDO by W3KET, Build-Save-Learn-Have Fun by W8VVD, and Up Front by the Staff. The winner by one lone vote was W8VVD who gets a check for another 50% payment on his article as a reward for your enthusiasm. W3KET made second, proving again that transistors are of great interest. The Kyle All Band Antenna placed 4th and Ignition Interference placed 5th. All had heavy voting.

The combination voting card and readers' service card in the April issue has greatly increased the voting. To date, with only a few hundred cards in, Nuvistor Converter by K8BYN and Noise Limiter by K5JKX/6 are neck and neck at about 200 votes each. Not too far behind is the big technical article again. This seems to make one of the top spots each month, guess we'll have to continue the series and maybe run two per issue eventually.

Tear the card out of this issue and send it in right away. This will serve several purposes: your magaizne will be easier to read with that confounded card torn out; we'll find out how you feel about the articles in this issue and be governed accordingly; and our advertisers will expectantly send you whatever literature or catalogs you request. If the response is good they may buy you more pages of magazine for next month. . . . W2NSD

Subscription Rates

While we do not consider a subscription blank an absolute necessity for starting or renewing your subscription, it may simplify matters for you. We have bound one in his issue so it is not necessary to rip your copy of 73 all to shreds. Rates: $3 per year; $5 two years; DX operators $4 per year. Back issues: 50¢ each. Subscriptions start from current issue only.

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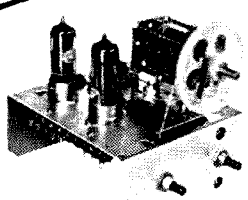
AMERICAN GELOSO V.F.O.'s



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Mod. 4/104, 4/102 or 4/103 less tubes and xtal, each $29.95

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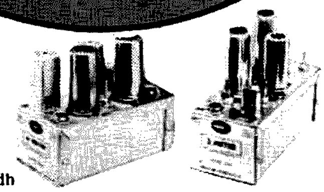

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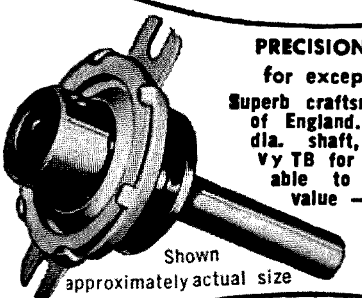

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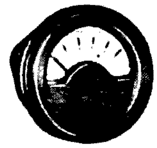

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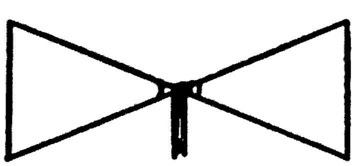

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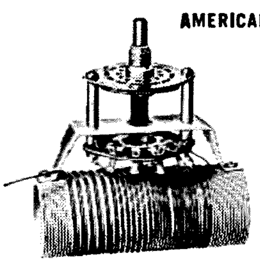

Units have 6 posit. tap switch mounted on ceramic coil form. Mod. 4/111 designed for use with two 807's or 6146's (in parallel). Freq. Range 3.5 to 29.7 mc.

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SAY YOU SAW IT IN 73

The Gee Four Zed Smith

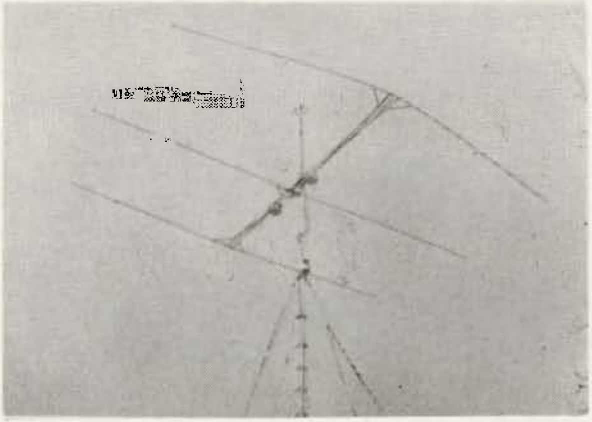

Fig. 1. You probably can't see the wire danglers on the end of each element to reduce the overall size of the Gee Four Zed Smith three band beam.

A compact, lightweight, remotely tuned tri-band beam

Hartland B. Smith W8VVD
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Birmingham, Michigan

How would you like to own a beam with these important characteristics?

1. It is light in weight, under 10 pounds, to be exact.
2. It is strong enough to withstand the high winds and icing conditions encountered during winter months.
3. The turning radius is less than 11 feet.
4. It has no traps or loading coils, items which are difficult to design, construct and adjust without extensive lab and shop facilities.
5. Each element can be tuned by remote control, right from the shack.
6. It performs satisfactorily on 14, 21 and 28 mc.
7. Best of all, the cost is surprisingly low.

The antenna at my QTH boasts all of these important features. The how and why of its construction are set forth in the following paragraphs.

Although plans for a great many different beams have appeared in ham publications during the last twenty years, none of these quite seemed to fit my needs. The one which came closest, however, was the G4ZU antenna described by Dick Bird in the *RSGB Bulletin*, *CQ*, *Revista Telegrafica*, etc. I decided that with a few changes and modifications, the G4ZU could be made to meet every one of my specifications.

Those of you who are unfamiliar with the design and theory of the G4ZU should refer to Fig. 2 which shows a popular version of this ingenious aerial. A twin boom supports the elements. The director, cut for the 28 mc band, is split at its center where a 28 mc open quarter wave stub is connected. The stub acts as a short circuit at 28 mc. Consequently, for all practical purposes, the director appears as though it isn't split at all. On 21 mc, however, the stub is no longer a short circuit. 21 mc energy cannot jump the gap in the director and so it must detour down the boom to the 21 mc shorting bar and then proceed out the other leg of the boom to the rest of the director. That portion of the boom between the director and the 21 mc shorting bar acts as a 1 turn coil which loads the director for 21 mc operation. Thus, the director is active on both the 28 mc and 21 mc bands.

The driven element is insulated from the boom and is fed with open wire line. It is an ordinary dipole at 21 mc. On the 28 mc band it appears as two shortened collinear elements, while on 14 mc it works as a single short dipole.

The 21 mc reflector, like the director, is split at its center. A 21 mc quarter wave open stub acts as a short across the break on 21 mc. At 14 mc, the stub is no longer effective and so rf energy must detour down the boom to the 14 mc shorting bar. As with the director, this arrangement provides a loading effect which resonates the reflector on 14 mc.

The beam acts as a two element affair on 20 meters with a radiator and reflector. Despite its smaller than normal size for a 20 meter antenna, performance on this band is quite good, especially if care is exercised in the tuning process. On 15 meters, the G4ZU

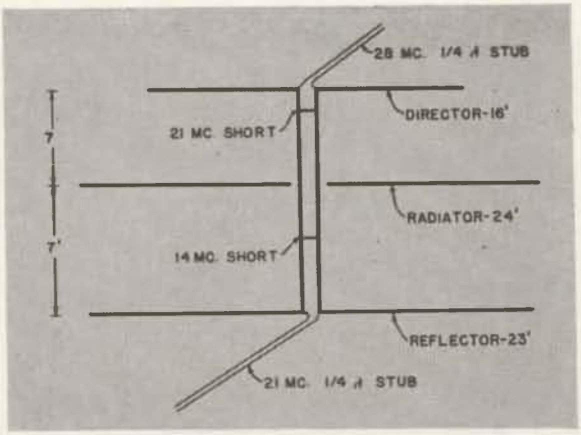

Fig. 2. Standard G4ZU beam.

performs as a 3 element beam with a full length reflector and a loaded director. Although only the radiator and director would appear to operate at 28 mc, the beam is more effective than an ordinary two element 10 meter aerial. According to G4ZU, this is because a significant amount of gain is contributed by the collinear configuration of the radiator. Additional 10 meter directivity is provided by the 20 meter reflector which acts as a non-resonant passive element. If you are interested in learning more about the theory behind this particular type of beam I suggest that you consult some of the references listed at the end of the article.

Because self-supporting elements must be fairly husky, I concluded that a standard G4ZU would be too heavy for my flimsy 36 foot dural mast. Consequently, I built my version out of ½ inch aluminum tubing held up by umbrella type guys. Although I used half hard tubing because it was given to me without charge, an ST alloy would be preferable since it has less tendency to take on a permanent bend in a severe wind storm.

In order to support the light weight elements, I extended the rotating shaft and ran guy wires from the top of the shaft to the elements and to the ends of the boom. The guy wires were insulated with electrical tape where they touched the shaft and the elements. The wires were also broken with plastic insulators to keep them from resonating at 10, 15 or 20 meters. If you examine Fig. 1 closely, you'll note that the guys tend to give the director and reflector a somewhat bowed appearance. Since element spacing is not critical, the effect on performance of this slight distortion is insignificant.

Even though the longest element of the standard G4ZU measures only 24 feet, I have tree problems which won't permit me to swing a beam of that size. For this reason I found it necessary to keep the horizontal spans of the radiator and reflector down to 18 feet. I fastened solder lugs to each end of these two elements with sheet metal screws. Wire danglers were then soldered to the lugs to make up the balance of the required electrical length. Strain on the soldered joints was minimized by insulating each dangler with electrical tape for a distance of about 3 inches from its associated lug and then wrapping the dangler once around the end of the element. To prevent moisture induced corrosion, the entire area around the solder lug was well taped. I used ordinary bare twisted antenna wire for the danglers.

Since the driven element is self resonant only on 15 meters, a tuned feedline is required for three band operation. Rotation is no problem if one end of a 4 foot length of tubular twinlead is connected to the radiator and the opposite end is fastened to a 2 inch open wire line which runs from a point near the top of the mast down into the shack. The tubular lead can twist and squirm during rotation without any danger of shorting out or significantly changing impedance.

Don't worry about TVI being accentuated by the open wire line. The antenna tuner which is required by this style of feeder definitely

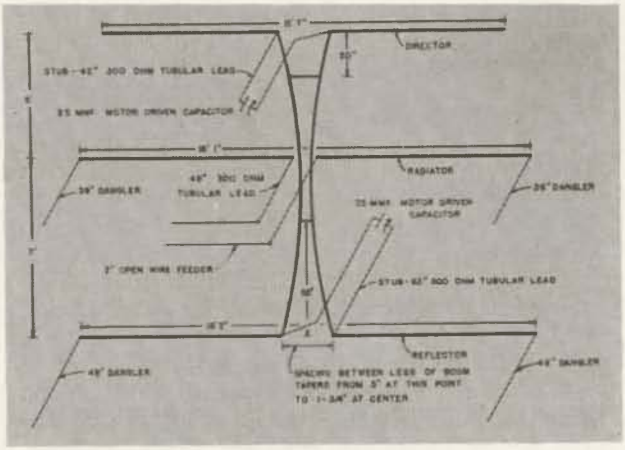

Fig. 3. Gee Four Zed Smith beam.

discriminates against harmonics which might escape from the low pass filter at the output of the transmitter. Line pickup and radiation apparently are insignificant because, as the beam rotates while the receiver is tuned to a steady signal, the S meter drops almost to zero on the ends and to a low value off the back.

The driven element may be peaked on any frequency in the 14, 21 or 28 mc bands by merely twisting a couple of knobs on the tuner which can be located near the operating position in the shack. Some other method, however, must be provided to remotely adjust the director and reflector. I chose 1 RPM timing motors to do the job. These are actuated by S4 and S5, toggle switches mounted on the panel of the antenna tuner. Suitable motors are listed in a number of mail order bargain flyers. Duplicates of the ones I used can be obtained for $1.25 each from Herbach and Rademan, Inc., 1204 Arch St., Philadelphia 7, Pa. Ask for catalog number TM4212X.

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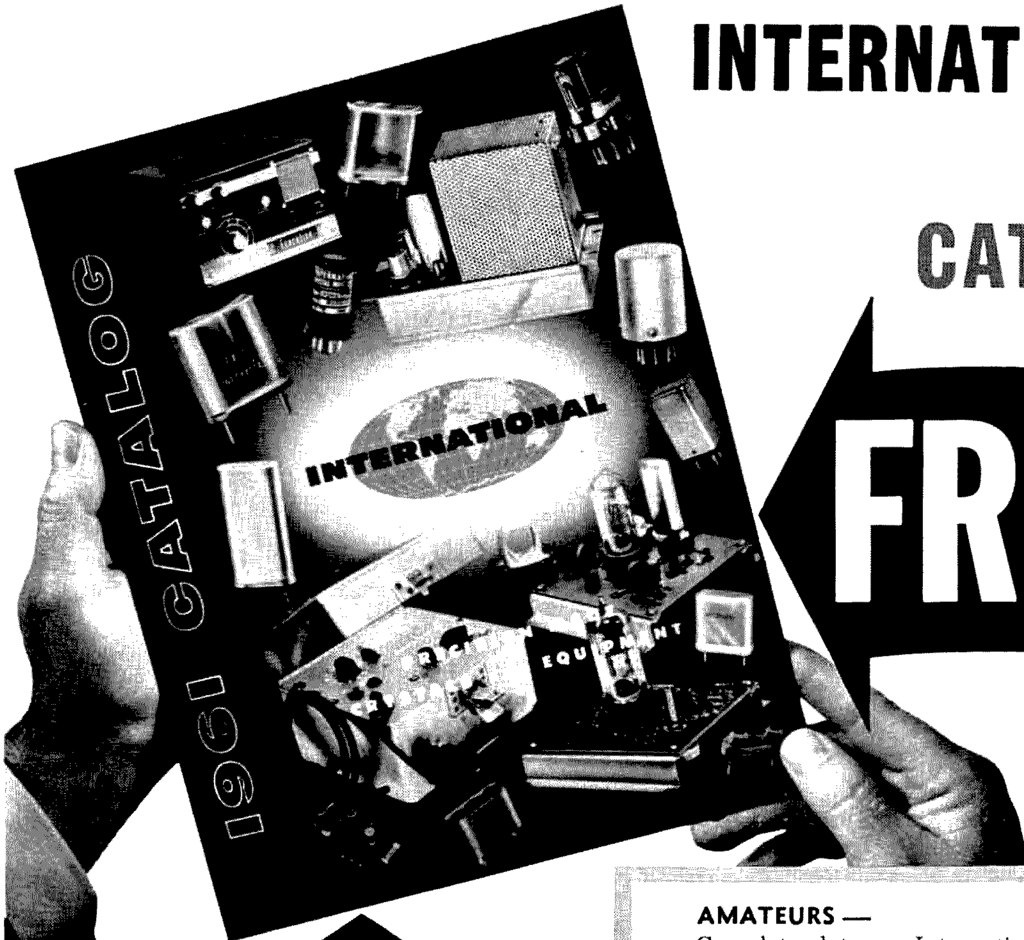

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Fig. 4. Plastic ice-box dishes protect the element tuning capacitors and motors from rain and snow. 1/4" shafts, soldered to the output gears of the motors, drive the capacitors via insulated couplings.

The motors drive variable capacitors which are wired across the open ends of the director and reflector stubs. The stubs, cut from Belden type 8275 foam filled 300 ohm twinlead, are made somewhat shorter than an electrical quarter wave and are then loaded by the variable capacitors. As these capacitors are tuned, the resonant frequencies of the director and reflector change to a noticeable extent. Since the capacitor rotors are not at rf ground potential, bakelite or ceramic insulated shaft couplers must be used between the motors and the capacitors.

A capacity of 25 mmfd and a plate spacing of 1/8 inch should prove satisfactory for the stub capacitors. No arc-over troubles have developed during two seasons of operating at transmitter powers of 1000 watts PEP SB and 350 watts AM while using capacitors with these specs. Housed in plastic ice box dishes, the capacitors are mounted as shown in Fig. 4, near the center of the boom. The exact positions of these containers depend on the lengths of the director and reflector stubs which run between their respective elements and the motor driven capacitors. The stubs can be supported below the boom by small standoffs cut from 1/4 inch sheet plastic.

Tape the control wires for the tuning motors to the boom and the shaft. Allow enough slack in them for rotation and then run them down the mast, preferably to the bottom, before taking them into the shack. This procedure will minimize rf pickup on the ac line.

Fig. 5 shows how the elements are mounted on the boom and also how the boom is fastened to the rotating shaft. Ordinary 6-32 bolts and sheet metal screws can be used for hardware, provided they are dabbed or sprayed with Rust-Oleum Primer, No. 769, to discourage rust and electrolysis. Also paint the spots where the reflector, director and shorting bars contact the boom. Apply two coats of good quality spar varnish to the wood dowels which act as element insulators and braces.

Like any other beam, this one must be carefully adjusted before it is mounted permanently atop a mast. Temporarily set it on a step ladder or other support at least 7 or 8 feet off the ground. Point the beam at a field strength meter located more than 100 feet away. Feed 28 mc energy to the radiator. Don't bother with a tuner at this time. Just hook the feedline directly to a low power transmitter. Turn on the director tuning motor. Trim the director a few inches at a time until the maximum field strength reading occurs when the plates of the director tuning capacitor are half meshed. Switch to 21 mc and set both motor driven capacitors to mid-range. Adjust the position of the director shorting bar and the length of the reflector danglers for the best meter deflection.

Rotate the antenna 180° or until the reflector is nearest the field strength meter. With 14 mc energy applied to the radiator, position the reflector shorting bar for a minimum field strength meter reading. Recheck several times on 28, 21 and 14 mc to make sure that adjustments for one band haven't seriously upset those of another. As soon as maximum forward gain on 28 and 21 mc and minimum back radiation on 14 mc all occur when the stub capacitors are half meshed, you can hoist the beam to its final location.

The antenna tuner is a bandswitching affair built into an 8" x 10" x 12" utility box. The coil dimensions and tap positions shown in the schematic are the ones which worked out best at my particular QTH. These values have been included only as a guide. Due to differences in feeder length and antenna height, you'll undoubtedly have to experiment a little to discover the best coil and tap adjustments. This procedure, however, won't be very difficult because a reflected power meter is included as a permanent feature of the tuner.

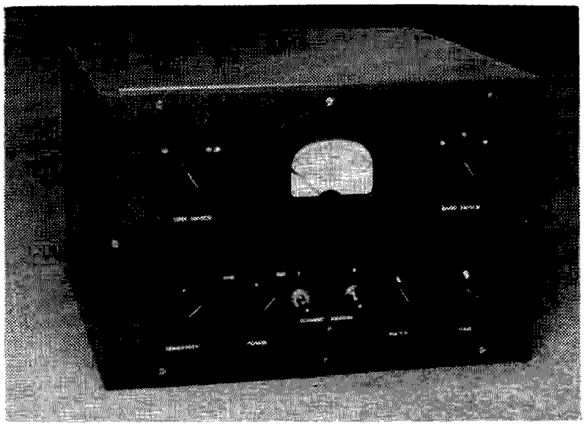

Fig. 6. The antenna tuner, reflected power meter and motor controls are housed in an 8" x 10" x 12" cabinet.

L1 is a 12" length of RG8U co-ax which has been modified to serve as a pickup line for the reflected power meter. It is prepared by first slitting and then removing the outer

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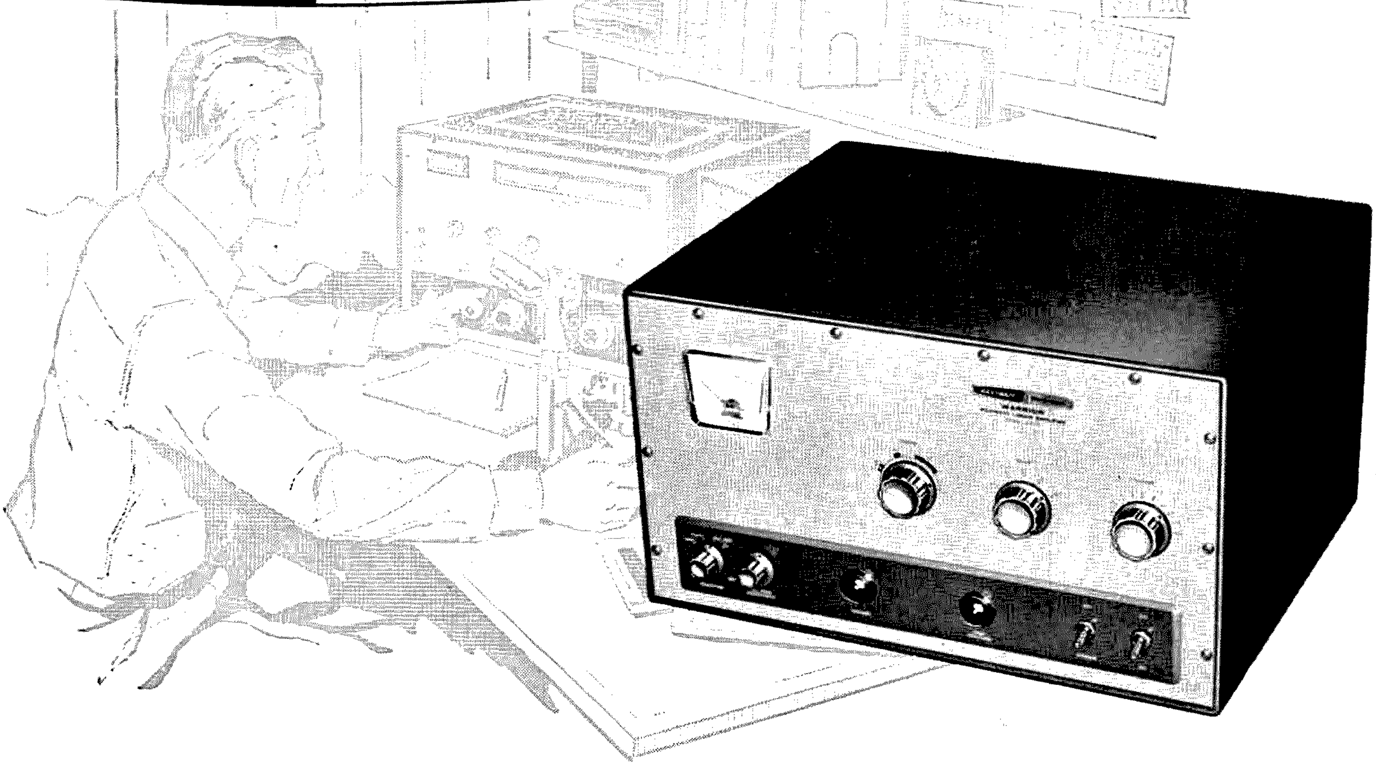

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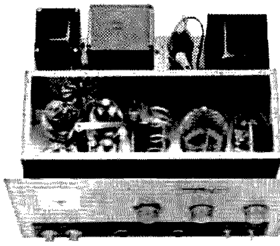

This inside view shows the neat circuit layout and husky components that emphasize quality. Note the internal shielding of plate circuit for maximum protection against TVI.

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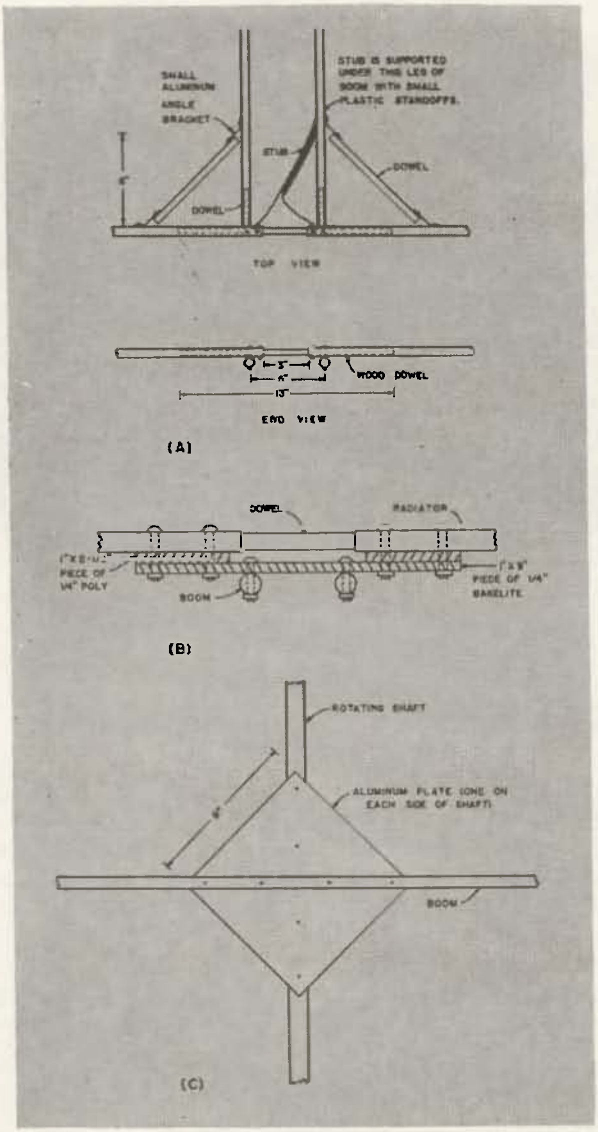

Fig. 5. (a) Method for mounting the parasitic elements to the boom. (b) Method for insulating the radiator from the boom. (c) Two square aluminum plates are used to fasten the boom to the rotating shaft.

vinyl jacket of the co-ax. About a half inch from each end of the section of co-ax, make holes in the exposed shield braid by means of an ice pick or the blade of a small screw driver. Thread a piece of fine wire through one hole and then along under the shield, next to the poly insulation, and then out the other hole. This can be most easily accomplished if you shorten the braid by pushing on each end so that it bunches up near the center of the co-ax. No. 30 enameled wire may be used if you are careful not to break the insulation during the threading process. I employed very fine plastic covered wire for the purpose. After the wire has been threaded through, stretch the shield out again until it assumes its original length. Replace the vinyl jacket on the co-ax and spiral wrap it with electrical tape.

The exact value for R1 must be found by experiment. Temporarily disconnect the wires which run from S1A to the 10 and 15/20 meter links, L3 and L5. Attach a dummy load between the movable arm of S1A and ground. The impedance of this dummy should match the output impedance of your transmitter or low pass filter. Use only non-reactive carbon resistors for the dummy. Feed 10, 15 or 20 meter energy from the transmitter into J1. Throw S2 to the FORWARD position and adjust R2 for a full scale reading on M1. Switch S2 to the REFLECTED position and try different values at R1 until the meter reads zero. The correct value for this carbon resistor will probably fall somewhere between 50 and 250 ohms. A carbon potentiometer may be used at this point if you'd rather not fiddle around with fixed resistors while trying to discover how many ohms are required.

After removing the dummy and replacing the L3 and L5 leads on S1A, you can hook the feedline from the beam to output connectors F1 and F2. Set S1 and S3 to 20 meters and S2 to FORWARD. Feed 20 meter energy from your transmitter into J1. Adjust the SENSITIVITY control, R2, until M1 reads full scale. Put S2 in the REFLECTED position and Tune C1 for minimum deflection of M1. Tune C2 and try to reduce the reading of M1 even more. At some combination in the settings of C1 and C2, the M1 reading should drop to zero indicating that the tuner is transforming the feedline impedance to that of the co-ax feeder from your transmitter or low pass filter. If a zero reading cannot be achieved, the 20 meter feedline tap positions on L2 should be changed. Bear in mind that the closer these taps are kept to the outer edges of the coil, the lower will be the circulating current. As a result, there will be less coil heating and power loss. Furthermore, the resonant point of the tuner will be broadened and you'll be able to QSY further from your original frequency without having to retune.

After locating the proper 20 meter tap positions, set S1 and S3 for 15 and make the necessary adjustments on that band.

While setting the tuner up for 10 meters you may find it necessary to stretch out or squeeze together the turns of L5 in addition to changing tap positions on L4 in order to achieve a zero reflected power reading. As soon as the coil taps for the three bands have been permanently located and soldered, you can put the tuner chassis into its case.

To go on the air, merely switch S1 and S3 to the same band as the transmitter. Put S2 in the FORWARD position and set R2 for a full scale reading of M1. Throw S2 to REFLECTED and tune C1 and C2 for a zero meter reading. When going from one band to another you'll find that this tune-up procedure takes only a minute or so. While not quite so convenient as a trap tribander, the Gee Four Zed Smith boasts a very important advantage.

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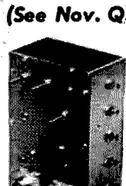

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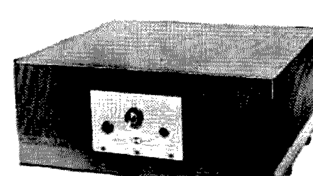

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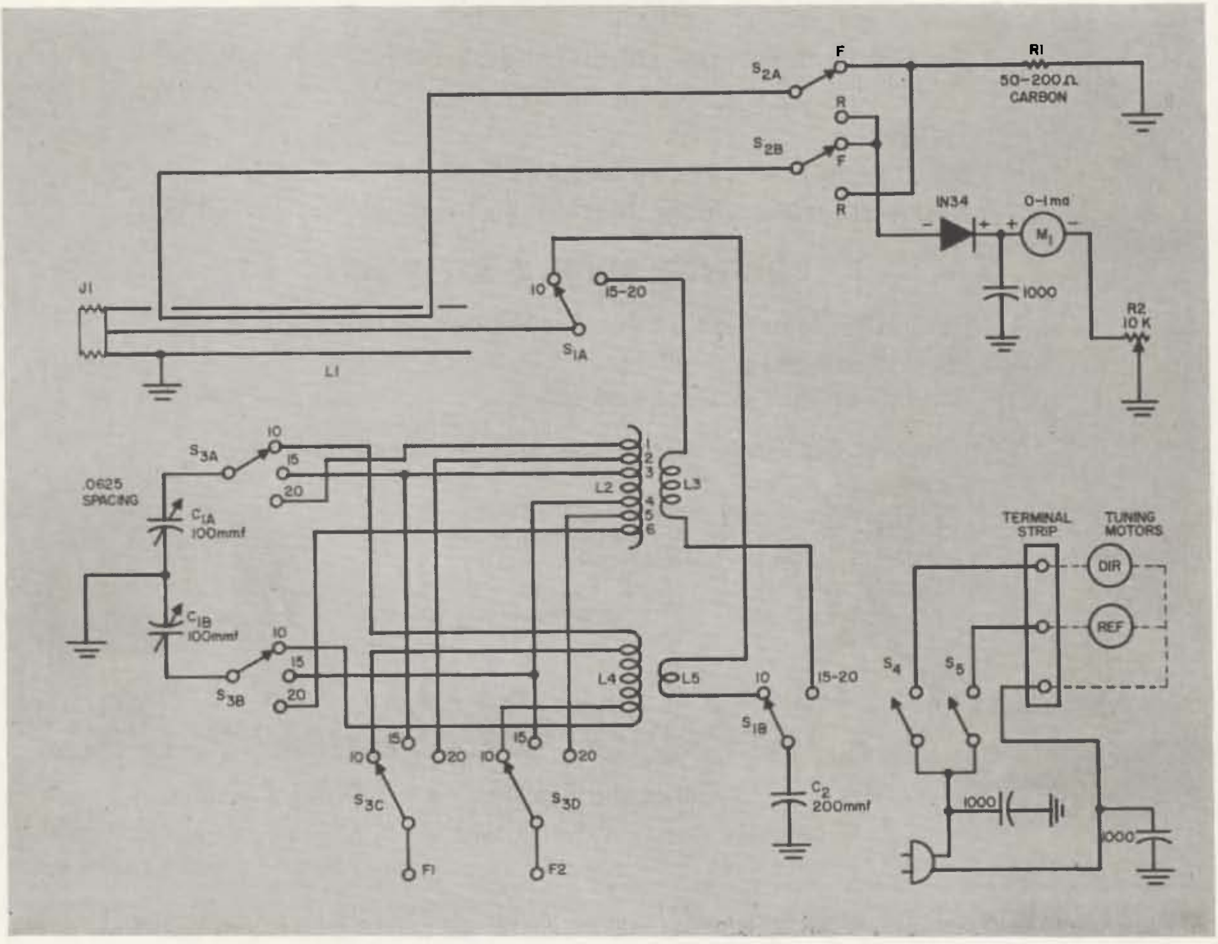
It radiates efficiently on only one band at a time. Thus, you need have little worry about putting out a 10 meter harmonic when you're switched to 20 or a 20 meter subharmonic when you're on 10.

The director and reflector can be remotely peaked for optimum performance in the following manner. Put your transmitter on your favorite 28 mc frequency and resonate the tuner by means of the reflected power meter. Turn off the transmitter and tune your receiver to a strong local signal near the same frequency. Point the beam toward the source of this signal. Throw on S4 to actuate the director tuning motor. Let it run until the receiver S-meter is at its highest point. Turn off S4. Switch to 14 mc. After resonating the driven element with the transmitter and tuner, put the back of the beam toward a steady local. Turn on the reflector motor with S5 and allow it to run until the receiver S-meter drops to its lowest value. Normally, if the director is peaked on 28 mc and the reflector is optimized for 14 mc, no 21 mc adjustment of the parasitic elements will be required. However, when you need that last db of gain for a 21 mc sked or to break through to some choice DX, you can touch up both the director and reflector to achieve the best possible performance.

Fig. 7. Rear view of tuner. L1 runs along right hand edge of the chassis. L2 and L3 are to the right of the two gang capacitor C1. L4 and L5 can be seen between the meter and the ceramic bandswitch S3.

If you live in a sparsely populated area with no nearby hams, use a transistor oscillator located several hundred feet from the shack as a signal source. Although you can check the results of your tuning efforts by feeding power into the antenna and having someone observe the deflection on a field strength meter, this arrangement is much less convenient than

Fig. 8. Schematic of Gee Four Zed Smith antenna tuner.



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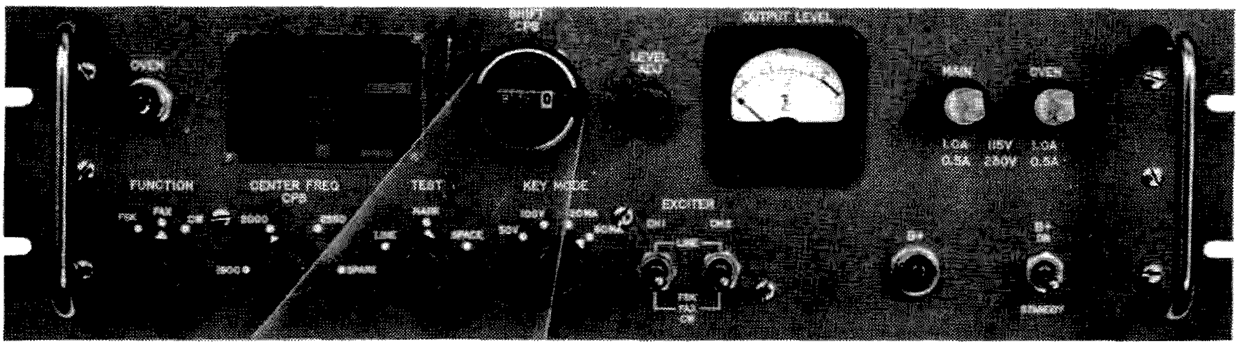

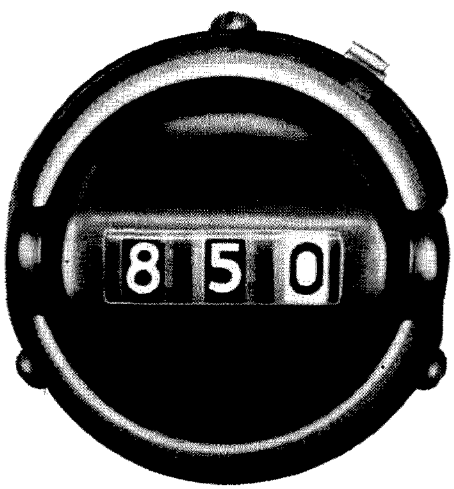

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the received signal method.

Originally designed especially for installation on a flimsy mast, the antenna worked so well during its first season that I decided to keep on using it when I changed to a tilt-over crank-up tower last fall. The 10 and 20 meter front-to-back ratio, according to a nearby 75A4, is about 20 db. On 15 the figure runs between 25 and 30 db.

Although no gain tests have been made, performance on 10 and 15 seems to compare very favorably with that of the average 3 element beam. When my 300 watter is feeding power to the antenna I can work just about every DX station I hear, often on the first call. Once, while using a 120 milliwatt transistorized CW rig, I raised a Puerto Rican without prearrangement. Another time I had a nice phone chat with a JA while running 25 watts to my exciter.

On 20 meters, the antenna provides excellent Stateside QSO's with lots of S9 plus, plus reports. I haven't tried serious 20 meter DXing, however, because it seems rather silly to buck the kilowatt QRM with a condensed 2 element beam, especially since it has proven so easy to get across the pond on 15 and 10.

Tuning changes which result from accumulations of moisture, snow or ice on the elements and feedline can be easily counteracted by a slight readjustment of the remote control circuitry. Even though high winds cause the danglers to flop back and forth a bit there seems to be no significant degradation of performance in breezes under 50 mph.

If you're cramped for space, have a thinly padded purse or require a beam that's suitable for mounting on a slender TV mast, I suggest that you carefully consider the advantages offered by this modified G4ZU. The fact that you can tune it right on the nose while comfortably seated in the shack is a plus feature well worth the effort required to build it yourself.

Coil Table

L1—See text.
L2—10 turns, no. 12 wire, 2½" diam., 1½" long. B-W 3905-1 (Air Dux 2006) Taps 1 and 6, ½ turn from each end. Taps 2 and 5, 1½ turns from each end. Taps 3 and 4, 3½ turns from each end.
L3—3 turns no. 12 wire, 2" diam., ¾" long, mounted inside L2.
L4—5½ turns no. 10 wire, 1½" diam., 1" long. Tapped 1 turn from each end.
L5—3 turns no. 14 wire, 1" diam., ½" long, mounted inside L4.

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Bill Roberts W9HOV
House of Antennas

Economy?

Cheapness alone does not make a bargain.

LOOK at the following table which has been offered by one of the leading cable manufacturers in which they describe the amount of attenuation on their products per hundred feet.

Attenuation per 100 feet

	3.5 mc	7.00 mc	14 mc	21 mc	28 mc	50 mc	144 mc
RG8U	0.30	0.45	0.66	0.83	0.98	1.35	2.50
RG58U	0.68	1.00	1.50	1.90	2.20	3.10	5.70
RG11U	0.38	0.55	0.80	0.98	1.15	1.55	2.80
RG59U	0.64	0.90	1.30	1.60	1.80	2.40	4.20
Open wire	0.03	0.05	0.07	0.08	0.10	0.13	0.25

Now, what does all this tell us? First let's say that we are using 100 feet of line (shorter lines and longer lines are proportionate). It is a commonly known thing that a gain of 3 db is equal to doubling of power (therefore a 3 db loss would halve it).

Let's take a hypothetical case where "A" runs 100 watts on 28 mc with a line 100 feet long. The table shows us that there is an antennuation of 0.98 db with RG8U and 2.20 db with RG58U. If a 3 db loss halves your power the 1 db loss with RG8U means you have lost 1/3 of 50 watts, or nearly 14 watts power. With RG58U you have lost 22/30ths or .73 of 50 watts. That figures to about thirty five watts.

Now let's look at it another way. Let's say you have 100 watts and you have chosen RG58U because it is cheap. You have saved a few cents a foot for 100 feet, that is true, but you have doubled your losses. As we have shown, you lose 14 watts with RG8U and 35 watts with RG58U. So you have saved about $6.00 on cable and you have thrown away 21 watts. At higher levels it is even more outstanding because the wattage goes up and the savings (??) stay the same.

With the cost per watt of present day transmitters it sure is poor economy to save money by buying less expensive coax. Moral—use the heaviest cable you can afford, or use open line if you have the nerve. . . . W9HOV

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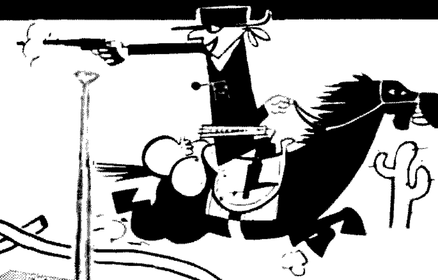

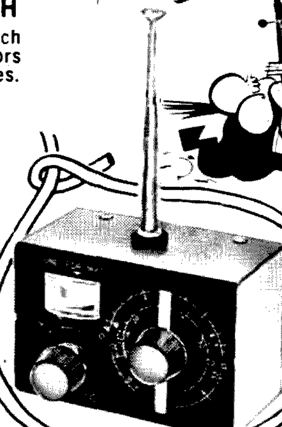

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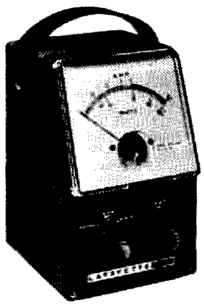

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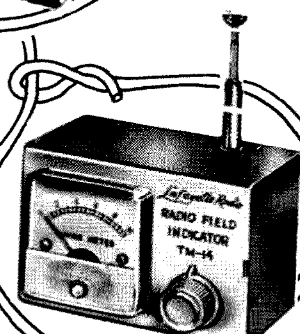

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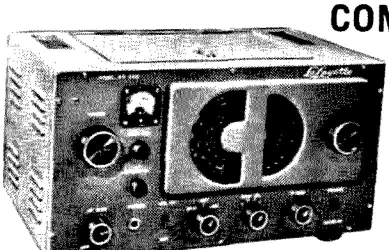

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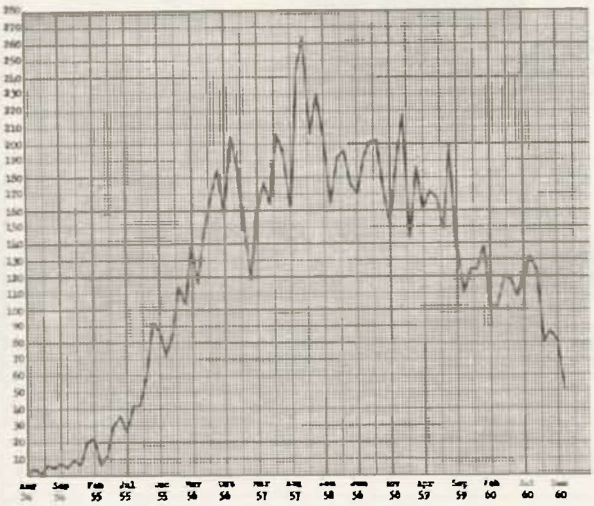
Propagation

Part I

David A. Brown K2IGY
Associate Editor

THE present Sunspot Cycle, Number 19, which reached an all time high in late 1957, is now rapidly on the decline. To understand what kind of DX conditions will exist this coming winter and for the rest of the cycle, it is important that one understands first, the Sunspot Cycle and second how propagation conditions follow this cycle.



The relative sunspot number is not the count of the number of sunspots seen on the disk of the Sun, rather, it is an index of sunspot activity observed on the entire visible disk of the Sun, which is determined each day by many observers throughout the world.

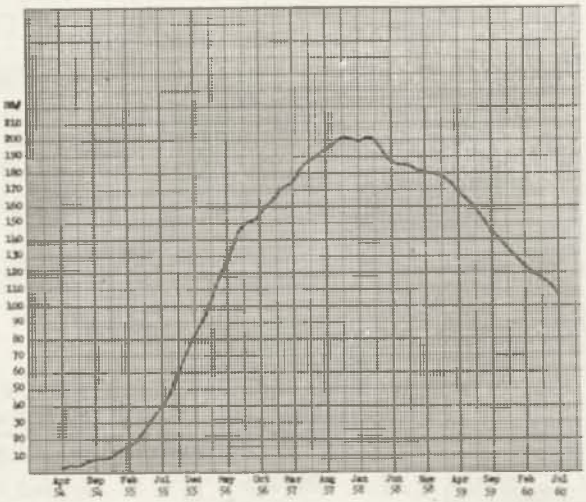
Sunspots usually occur in groups and the Relative Sunspot Number was set up to include the number of groups as well as the number of spots, and is defined as: $R = k(10g + s)$, where R is the relative sunspot number; k is a scale factor (usually less than one) which depends on the observer and his instrument and is intended to be used as a conversion back to the original scale set up by Wolf in 1849; g is the number of groups or clusters of spots; s is the number of individual spots. This number is determined each day and the average (mean) value given for each month. The American Relative Sunspot Numbers are designated RA, and the Zurich Relative Sunspot Numbers as RZ. Fig. 1 is a graph of the RZ numbers.

Examination of Fig. 1 will show that the sunspot number is a highly unpredictable quantity in itself, but the cyclic nature is easily seen. Note that the maximum RZ number occurred in October, 1957 and was 262.9. The highest daily number ever observed was 355 on December 24 and 25, 1957.

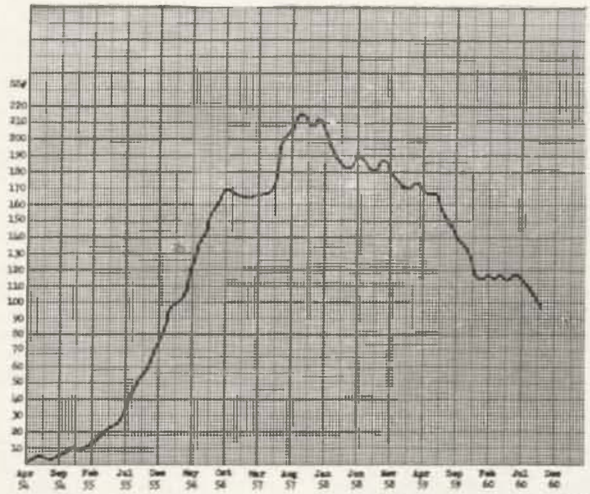
In propagation analysis we are interested in the 12-month running average of the RZ numbers, for it is this smoothed curve that the yearly variations in MUF follow, and not the very erratic variations in Fig. 1.

Fig. 2 is the 12-month running average of the RZ numbers and it is this curve that we call the "Sunspot Cycle." Sunspot Maximum is the time when the Sunspot Cycle reaches its maximum value, and not when the RZ numbers are highest.

The time of Sunspot Maximum is not easy to determine, in fact there is an apparent discrepancy between the American and Zurich maximums, probably due to the method of reduction of the observations. Most maximums are quite broad and there is always some uncertainty in the determination of the time of greatest activity on the Sun. A difference of over a year between RZ and RA, maximums is found in the present cycle, RZ having occurred in 1947.5 and RA, in 1948.8. The Zurich Sunspot Cycle is used as the standard, and to date there is data for eighteen complete cycles, the current one being Number 19.



The most reliable data is for cycles #8 through #18. This data has been averaged and the result is called the Mean Sunspot Cycle, which has a period of 11.1 years. The rise from minimum to maximum takes 4.6 years while

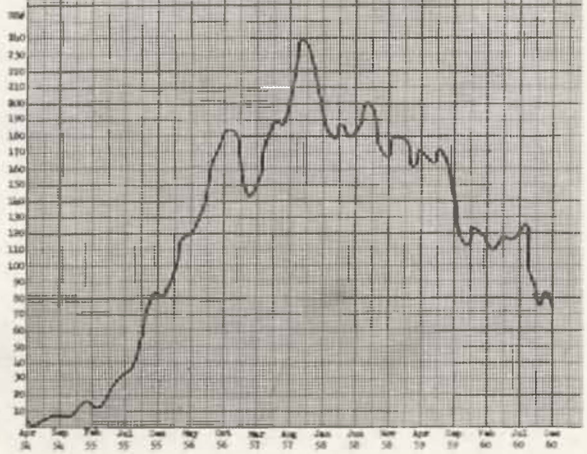


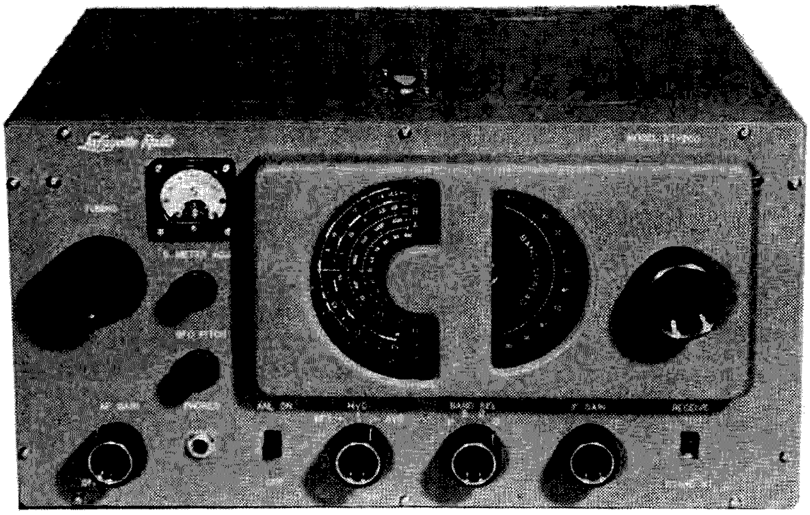
the fall from maximum to minimum takes 6.5 years. The average maximum number is around 96.4. The length of a cycle is determined from one maximum to the next. The shortest cycle was 7.3 years (1830-1837) and the longest 17.1 years (1788-1805). For this reason it is practically impossible to predict when the next maximum will occur in advance with any reliability.

The present cycle reached a maximum around 1957.7 making the length of cycle #18 only 10.2 years long, almost a year shorter than the average cycle. We are now most interested in when the next minimum will occur. Since the twelve-month running average values of RZ are six months behind the RZ values, the last six months of the Sunspot Cycle have to be predicted. Also, the data for predicting the MUF's must be available for at least three months in advance, based on current Critical Frequencies and a predicted Smoothed Sunspot Number. This means that the smoothed numbers should be predicted at least ten months in advance.

To aid in the determination of the smoothed numbers, I use a seven month and a three month smoothed running average, curves which are Fig. 3 and Fig. 4 respectfully. Notice how the curve in Fig. 3 approximates the smoothed

(Continued on page 53)





Allie C. Peed, Jr. K2DHA
34 Ashley Drive
Rochester 20, New York

The Lafayette KT-200 Receiver

a review

As a kit, the KT-200 represents a departure from the usual kit practices. As soon as you unpack it, you'll note that by the usual kit standards you are about half finished already. All of the mechanical mounting is already completed for you. Tube sockets, transformers, main tuning capacitor, filter capacitor, controls, and even knobs and pilot lamps are all in place. The tuning mechanism is already installed and operative. The dial cords are strung and the flywheels are in place. And, best of all, the complex assembly of coils and alignment capacitors for the oscillator, mixer, and rf amplifier stages are mounted and prealigned, but more about this later.

Circuitwise, the KT-200 is conventional, straightforward, good design. It consists of a 6BD6 rf amplifier, a 6BE6 mixer, a separate 6BE6 oscillator, two 6BD6's as 455-kc *if* amplifiers, a 6AV6 detector, avc rectifier, and first audio amplifier, another 6AV6 beat frequency oscillator and shunt-type noise clipper. A 6AR5 serves as the audio power amplifier and a 5Y3 as the rectifier completes the nine-tube complement.

It is to be noted that many receivers commonly use a single 6BE6 pentagrid tube as both oscillator and mixer. However, in the interest of stability, the designers of this circuit have chosen to devote separate 6BE6's to the mixer and oscillator functions. This contributes to stability since it greatly reduces the tendency of the oscillator to "pull" on strong signals and probably it also lessens thermal drift problems.

AVC voltage is applied to both the rf and *if* amplifier stages. A front panel control provides for disabling the avc in its mvc (Manual Volume Control) position. This same switch in its third position (BFO) serves the dual purpose of turning on the beat oscillator and disabling the avc for copying CW or SSB signals.

Instead of the traditional rf gain control, the KT-200 is provided with a manual *if* gain control. Thus, the rf amplifier runs fully open all of the time except as modified by the avc bias. A minor point here is that the *if* gain control is simply a 10K potentiometer in series between ground and the two cathodes of the *if* amplifier tubes. Therefore it does not afford a complete range of control from cut-off to full gain as is the case with rf gain controls. It does, however, provide sufficient control to keep strong signals from over-driving and distorting.

A stand-by switch opens the plate supply lead to the rf amplifier, mixer, and oscillator stages while leaving the remainder of the stages powered. This is perfectly adequate and probably contributes to quick recovery time and stability when break-in operation is used. The stand-by switch terminals are brought out to a five-pronged socket on the rear apron of

the chassis for connection to a break-in relay in the station control system if desired.

All of the components are of Japanese manufacture and appear to be of excellent quality. The use of a few wax impregnated by-pass capacitors is probably the lone exception. While these are of good quality, modern receiver construction practice is to use plastic or ceramic encapsulated capacitors which can be expected to give longer service.

The cabinet, panel, and chassis are a pleasant surprise. They are of heavy gauge steel including two heavy diagonal braces between the chassis and top of the front panel. This contributes to the receiver having the ruggedness of a piece of military gear when completed. It should assure good mechanical stability of the finished assembly. The cabinet and panel are finished in gray wrinkle finish, and the cabinet is provided with numerous louvres to allow good circulation and heat dissipation from the interior. Both bottom and top are provided with hinged access doors of ample size and good fit.

A unique feature of the chassis is that ground points are formed by punching out "U-shaped" tabs in the chassis. These are bent out from the underneath side of the chassis by the constructor and ground leads are wrapped around them and soldered. This feature should give positive grounds avoiding difficulties with loosening of screwed-on ground lugs, and interface corrosion between ground lugs and the chassis. However, the kit builder using a low wattage soldering iron might encounter difficulty in heating these ground tabs hot enough to assure a good solder job.

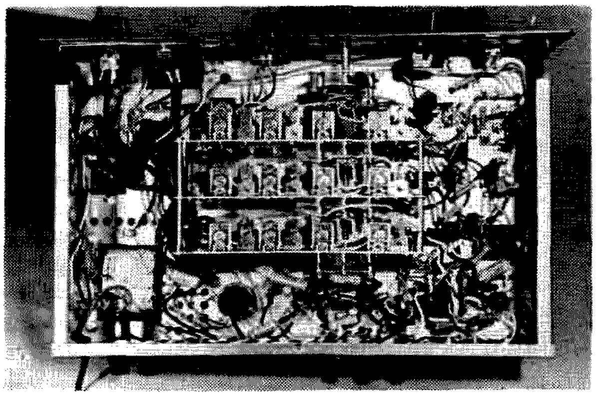
The S-meter is one of the small 1½ inch square type and it is connected with a multiplying resistor and calibration control from the cathode of the rf amplifier to ground. Essentially, it measures the voltage developed on the cathode which is a direct function of the strength of the received signal. Calibration of the S-meter is accomplished by temporarily shorting the antenna terminals on the back of the set and adjusting the "S Meter Adjust" control on the front panel until the meter reads zero. Unfortunately, this zero position varies from band to band and requires frequent re-adjustment if you are band-hopping. When the meter is adjusted to give proper readings on the short wave bands, switching to the broadcast band will pin the meter unless you back off on the control. Then you are out of calibration when you return to the higher frequency bands. Perhaps the best operational scheme here is to tune the receiver to a clear spot on the band in question and adjust the control to make the meter read just slightly above zero. Your S-meter readings then will be in terms of signal strength above background noise which is a meaningful relative reading.

Assembly of the kit consists chiefly of wiring in all of the components which are mounted on their pigtail leads, and connecting the terminals of those items which are premounted on the chassis and panel. The only part which might be considered difficult is the wiring of the bandswitch since this requires careful attention to directions and some work in rather cramped space at times. Total wiring time for a careful, experienced worker shouldn't exceed ten to twelve hours, and even the rankest novice kit constructor should be able to complete the job in fifteen to twenty hours.

Pre-Alignment

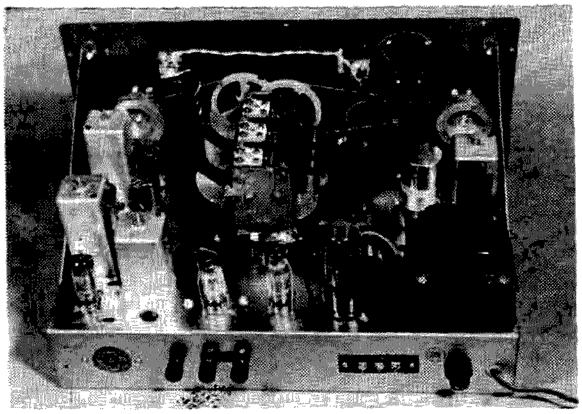
Your writer has, through experience, developed a tongue-in-cheek attitude toward kits which are sold claiming pre-alignment of the tuned circuits. Most such kits result in a completed unit which is aligned well enough to work after a fashion, but most of them require alignment for optimum operation. The KT-200 proved to be almost an exception however. By virtue of the fact that the tuning coils and capacitors are premounted and aligned, the overall alignment was quite good and only required a minimum of touching up to achieve the sensitivity and selectivity claimed in the specifications. In particular, the frequency calibration of the main tuning dial scales was outstanding. Anyone who has ever spent hours tuning between the top and bottom of four bands while juggling padder and coil adjustments will certainly appreciate this feature of the KT-200.

Similarly, the *if* transformers were close enough to proper alignment to allow them to be peaked by ear by the kit constructor who is not equipped with a signal generator and voltmeter. The only exception to this good



alignment was the bfo coil which was considerably out of tune. However, this is aligned by simply adjusting the core until a zero beat is heard in the speaker or phones, and hence it was not difficult to bring into line.

It was previously mentioned that frequency calibration of the main tuning dial was excellent. However, two-dial tuning of this type in general suffers from poor re-set accuracy and since, in this case, the main tuning dial



does not have index marks for setting to the amateur bands, location of the ham bands becomes a small problem. The bandspread dial is not calibrated except for an arbitrary 0—100 logging scale. The selectivity of the receiver is good enough to justify the use of a great deal of bandspreading, i.e., the bandspread control provides for a slow tuning rate enabling accurate tuning. But, this good feature is at the expense of coverage on the bandspread dial and one complete sweep of the bandspread scale does not cover fully any ham band in its entirety. It is necessary to reset the main tuning in order to tune a whole band.

If a 1000 kc crystal calibrator is available, it can be used to good advantage in spotting the proper ham band settings of the main tuning. Set the bandspread dial to 100 (maximum capacity) and tune in the 1000 kc marker at the lower end of the band in question. Then the bandspread will tune up the band from the lower edge. At the limit of the bandspread tuning if you wish to tune further up the band, it will be necessary to "fudge" the main tuning up a fraction. In practice, this isn't as much of a handicap as is sounds since the bandspread is sufficient to cover the entire phone or CW sub-band on most of the bands, and it is seldom that an operator operates both modes at one operating session.

The lack of bandspread calibration is no real handicap in modern operation which calls for zero-beating the station that you are working with your transmitter vfo. You must, however, assure yourself that your transmitter is operating within the proper frequency limits by some other method than your receiver's calibration, unless you provide the receiver with a crystal calibrator and learn to use it properly.

Mechanically, the bandspread tuning is interesting. In the main tuning capacitor, one plate is omitted in the center of each of the three rotor sections. Then, on a separate shaft from the opposite side of the capacitor, a single plate is turned into this gap in each stator section from the bandspread tuning shaft—a very neat arrangement.

The instruction manual is quite complete, but there are a sprinkling of errors and omissions which must be watched. For example, a correction sheet enclosed with this particular kit changed the instructions for wiring the main filter capacitor. However, this kit appeared to have one of the original type capacitors in it. When wired according to the correction sheet, the second section of the filter capacitor was connected with reverse polarity and the first section was ungrounded. As a result, all of the voltages were low by a large amount and there was excessive hum. Indeed, this could lead to the demise of the filter capacitor if not found and corrected quickly. Reference to the terminal notation on the capacitor can clear up this problem.

A couple of omissions which will be caught quickly by the experienced kit builder but which might trip the novice are worthy of mention. One relates to the pilot lamp wiring. There are two pilot lamps—one for each tuning dial. The instructions direct the wiring only of the one on the bandspread dial while the second one is not mentioned or shown in any of the illustrations. Perhaps this a change in the design which has not yet been worked into the manual. It is necessary only to run a couple of leads from the wired lamp socket to the other one in order to make both operate.

Another oversight appears in the rather detailed instructions for aligning the bfo. In the course of this procedure the manual fails to direct that the bfo be turned on with the front panel switch.

In the tabulation of voltages, the instructions fail to give directions for the settings of all of the front panel controls. This can lead to some readings which are perfectly normal but quite at variance with those given in the table. For example, it is obvious that the bfo must be turned off to obtain the readings given in the tabulation on the bfo tube. Likewise, some of the grid voltages will be different from those in the table depending on whether the avc is activated or not, and whether a signal is present or not.

Modifications

Two modifications suggest themselves as being worth consideration by those who may assemble one of these units in the future. One is to take advantage of the three unused prongs of the five-prong rear apron socket to bring out a power take-off for a Q-Multiplier, TR Switch, crystal calibrator, or other low-drain auxiliary station accessory. Connect one pin to ground, one to the 6.3-volt filament line, and one to the plate voltage from the output of the filter. It is a good idea to mark these on the chassis beside the socket so that when you want to use it, you can recall how you wired the socket without having to open the cabinet and trace the wiring.

The second modification relates to the 10-watt resistor used as part of the power supply

filter (R21). This generates considerable heat and it is in rather close proximity to the oscillator coils and padders. Since the set was found to have a very substantial amount of drift for about the first ten to fifteen minutes of its operation from a cold start, it seemed prudent to move this resistor over to the side of the chassis away from the coils and nearer some of the ventilating holes. This move diminished the warm-up drift appreciably and made for more rapid stabilization.

The bfo in the particular unit tested failed to provide sufficient injection to allow for good SSB reception. It was necessary to increase the size of the small tubular capacitor which coupled the bfo output into the second detector. The 2.2-mmfd capacitor supplied was too small. A 10-mmfd disc ceramic gave more suitable injection level and an even larger one might be desirable. (Two pieces of hook-up wire twisted into a gimmick capacitor might serve as well.)

While the receiver is capable of good SSB reception, it must be observed that tuning in a sideband signal with the small bfo knob on the panel can be a bit tedious. A larger knob, or planetary reduction drive would be of some assistance.

Operation of the KT-200 for a limited time since its construction has left the impression that it is definitely a hot performer even on ten meters where many single-conversion general coverage units with 455-kc *if*'s fall down. No problem was encountered with images, no doubt due to the isolation and attenuation provided by the rf amplifier stage. Sensitivity is very good and selectivity is adequate although the addition of a Q-Multipler would be useful for operation in the crowded ham bands. After the warm-up drift previously discussed, the stability is excellent—good enough even to allow satisfactory reception of single sideband signals. Incidentally, as sort of a bonus, this receiver is an outstanding performer on the broadcast band.

In summary, the KT-200 appears to be an excellent value for a middle-priced general coverage receiver. It is worthy of serious consideration by anyone ready to graduate from the inexpensive five or six tube general coverage receivers, but not yet in a position to purchase one of the top-flight communications receivers. Or it might be useful as a second receiver to supplement your ham-band-only hearing aid.

. . . K2DHA

The Ideal Ham Calendar

R. M. Case K4YNO

Hey	Fri.	Fri.	Thu.	Wed.	Sat.	Sun.
8	7	6	5	4	3	2
16	15	14	13	12	11	9
23	22	21	20	19	18	17
31	30	29	28	27	26	24
38	37	36	35	34	33	32

Down through the ages civilization has developed into its present, though ever changing form. In the wake of its evolution it has left the remains of inumerable outmoded ideas and once useful articles. Some of these have been revised to meet the times, while others were simply discarded.

One thing that has survived unscarred and unchanged throughout centuries of use and misuse is the calendar.

After many long years of diligent research on the subject I have developed the following plan for calendar revision. I propose that this plan be adopted for the good of all amateur radio operators and any and all individuals associated with them.

Hams, as everyone knows are inclined to "put off till tomorrow what should be done today." With this calendar you can put off washing the car on the seventh and still get it done by the third.

Ever notice how your Friday night net meetings always clash with the XYL's bridge parties or other great social occasions which demand your presence? No longer. Not with two Fridays in each week!

Now you can go ahead and buy that expensive KW rig you've had your eye on without worry about the first of the month payments on it as there isn't any first. The tenth and twenty-fifth have also been eliminated in case you are asked to pay on those days.

The number of week-days has been cut to four leaving a glorious three-day week end for hamming.

Those bothersome Mondays have been eliminated altogether and an extra day: Heyday has been added to round out the week. It is hoped that with a little persuasion Frank's Country Cousins would allow unrestricted operation on this day.

After you have carefully scrutinized the intricate details of this wonderful new calendar and feel that you would like to join our campaign for its adoption please stop by our headquarters at the S.A.H.F.H.B.A.O.C.H.**

If you don't have enough time to devote to this worthy cause at least stop by to see us some time. We are allowed to have visitors from one till four o'clock on Wednesday and Friday afternoons.

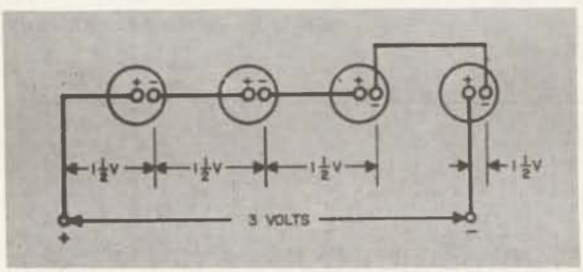
**Sunny Acres Home for Half Baked and Otherwise Crazy Hams.

Build a Vary-Volt

Joseph Leeb W2WYM
549 Green Valley Road
Paramus, New Jersey

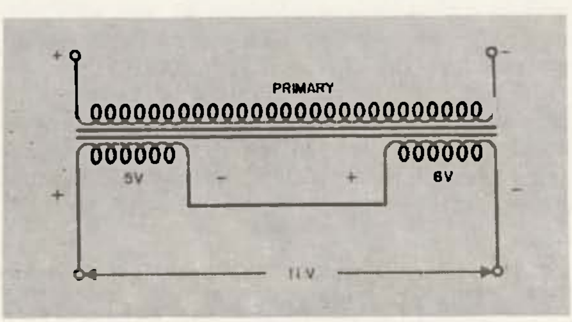
A variable-voltage supply is generally in the luxury class, as far as the average experimenter is concerned—nice to have, but expensive. Yet it need not be beyond your reach, because you probably have the makings in your junk box right now. Once you've used the Vary-Volt, you'll wonder how you ever got by without one.

Before digging into the construction, let's



see how the Vary-Volt works. Suppose we start with some dry cells. We all know that if we connect our cells in series, observing polarity, the final voltage is the sum of the voltages of all the cells. If each cell delivers 1½ volts, two in series will give 3 volts, three in series, 4½ volts, and so on. A little carelessness in observing polarities, however, will give some unexpected results. For example, four cells, connected as shown in Fig. 1, with one cell reversed, will give, not 6 volts, but 3 volts! The first three cells give 4½ volts, but the fourth cell, being connected with reversed polarity, bucks the voltage of the first three cells, and the result is 4½ minus 1½, or 3 volts.

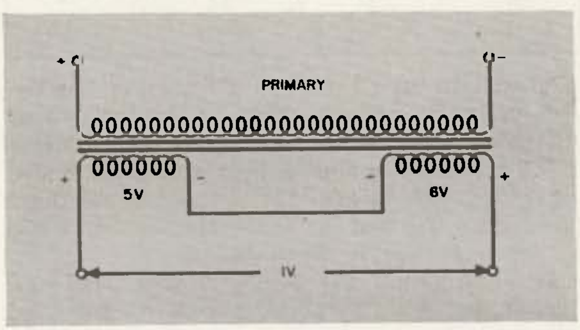
Although we are not accustomed to thinking of transformers as having polarity, their windings do, nevertheless, have definite polarity at any given instant when the current



flows. If we connect two windings on a transformer in series we will get either the sum or the difference of the two voltages, depending upon whether we connect the windings "series adding" or series bucking." (See Figs. 2 and 3). In our case the primary is used with the filament windings, making the Vary-Volt an auto-transformer with buck and boost.

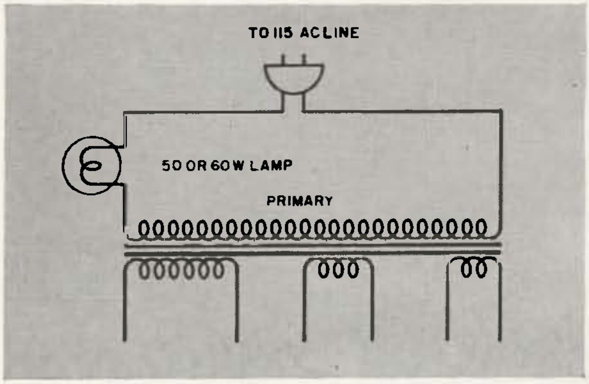
To build the Vary-Volt we need a filament or power transformer with several filament windings. An old TV transformer will do nicely.

With the aid of an ohmmeter locate the winding with the highest resistance. This is the high voltage winding and will not be used, so tape up the leads carefully to keep them out of harm's way. Now find the winding with the second highest resistance. This is the primary; put a tag on it. The remaining windings are the filament windings.

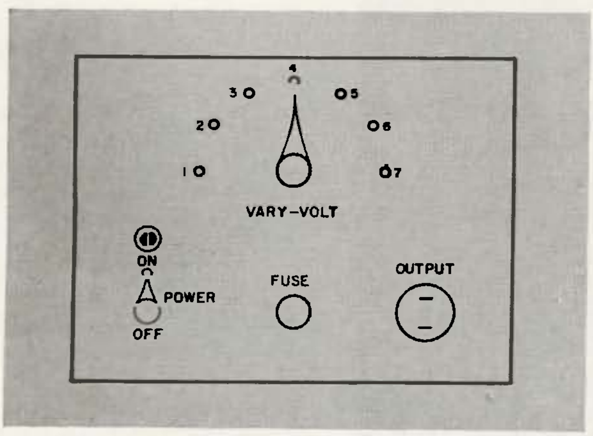


Connect a cord and plug to the primary in series with a 50 or 60 watt lamp. The lamp is a safety precaution, used only while checking out the windings. Hook up the filament windings in series and plug the primary in to the 115 volt ac line. Measure the total voltage of the windings. If it adds up to the sum of the individual filament winding voltages the terminals are correctly polarized with respect to each other. If the reading is less than expected, some of the connections will have to be reversed. This is done by measuring first one winding by itself, then two in series. If the two voltages add, connect in the third. Again, if the three voltages add, OK; if they buck, reverse the terminals of the winding.

By connecting the filament windings in series with the primary in such a manner that



the secondary voltages add to the primary voltage, or reduce it by bucking action, we have a range of adjustment from line voltage minus all secondary voltages up to line voltage plus all secondary voltages. For example, if our transformer has filament windings delivering 6.3, 6.3 and 5 volts, and the line volage is 115, then our Vary-Volt will give from 115 minus 6.3, minus 6.3, minus 5, or 97.4 volts, up to 115 plus 6.3, plus 6.3 plus 5, or 132.6 volts. The two-deck seven-position switch accomplishes this by tapping off the desired number of windings in series with the primary, and proper switching of polarity. For



example, when the switch is in positions 1 to 4, the lower deck connects the filament windings in series-bucking with the primary. In switch positions 5 to 7 the lower deck reverses the connections to the filament windings, placing them in series-aiding with the primary. The upper deck of the switch selects the desired voltages.

Construction of the Vary-Volt is quite simple. Dimensions have not been included since they will vary with the size and shape of transformer available. The panel may be fastened to a wooden baseboard or mounted in a ventilated cabinet. Prepare the panel for drilling and cutting by following Fig. 5. Mount the voltage selector switch, power switch, pilot light, fuse holder and outlet as shown. Wire according to the diagram. Use color-coded wire if available. This will reduce chances of error and make troubleshooting easier.

With the wiring completed, plug the Vary-Volt in to a 115 volt ac outlet. Check the output voltage with an ac voltmeter. If the voltage at each point on the selector switch is not according to the Table in Fig. 6, recheck the wiring, keeping in mind that the points on the selector switch become reversed when viewed from the rear.

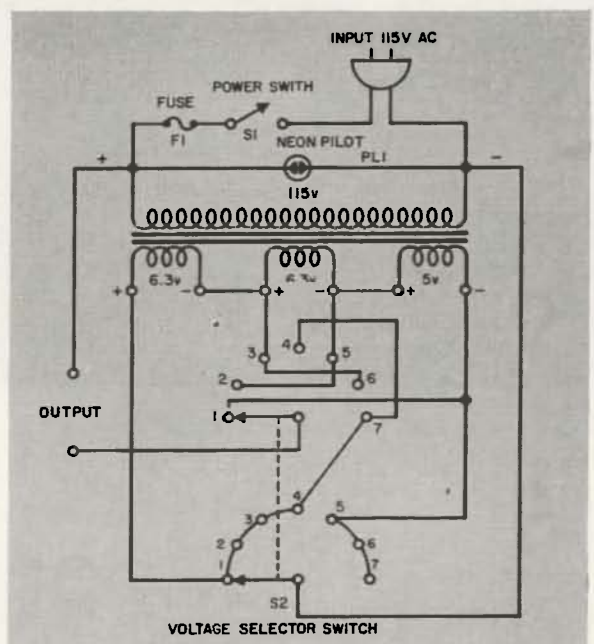
As we warned you in the beginning, you'll wonder how you ever managed without a Vary-Volt. There is nothing better for tracking down intermittent conditions in electronic circuits caused by either excessively low or excessively high line voltage.

Does your electric drill run too fast? Slow it down with the Vary-Volt. Like to dine by subdued light? The Vary-Volt makes an excellent dimmer. Soldering iron too sluggish? Boost its voltage with the Vary-Volt. Each time you use this handy shop gadget you will find more new and exciting applications for it.

. . . W2WYM

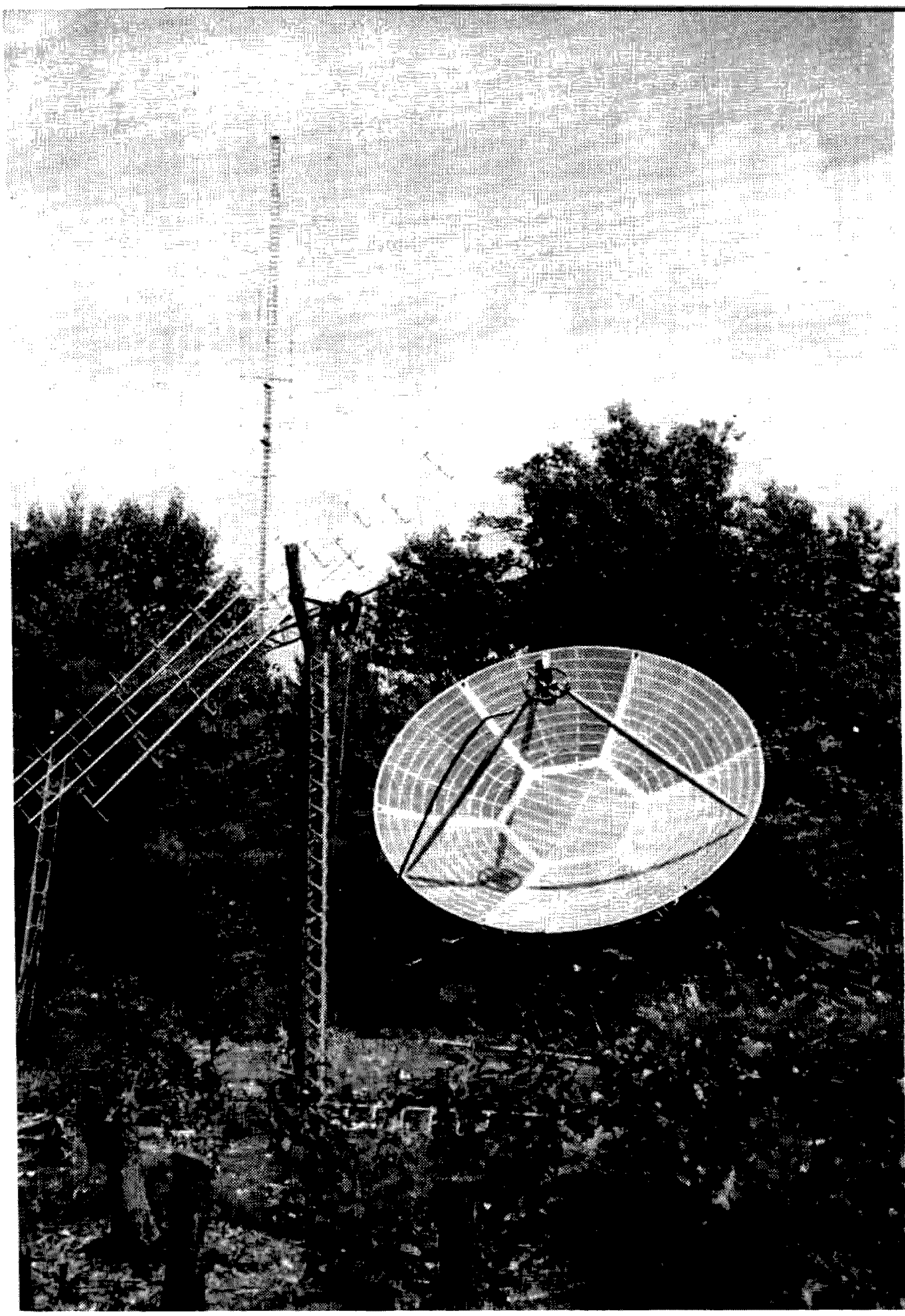
Parts List

T1—Filament or power transformer with several filament windings.
S1—Toggle switch.
S2—2-deck, 7 position wafer switch.
F1—Fuseholder and fuse. Fuse amperage depends upon transformer size.
PL1—115 volt neon pilot light and socket.
J1—Panel type convenience outlet.
AC line cord and plug.
Panel and box; size dependent upon transformer dimensions.
Hardware: solder, wire, screws, nuts, washers, etc.



SWITCH POSITION	VOLTAGE
1	115 -5 - 6.3 - 6.3 = 97.4
2	115 -6.3 - 6.3 = 102.4
3	115 -6.3 = 108.7
4	115 -0 = 115.0
5	115 +5 = 120.0
6	115 +5 + 6.3 = 126.3
7	115 +5 + 6.3 + 6.3 = 132.6

W1BU



Moonstruck

Dave Bell, W8GUE/6
3209 North Marengo Ave.
Altadena, California

I could see the outline of the big dish against the full moon as I followed Jack through the hanging feedlines to Building C (the chicken coop.) I fought my way through the bushes which had somehow survived the throngs of hams who had pushed them aside. Jack threw a switch with the ceremony of lighting up a world's fair. He has a flair for the dramatic. And well he might. The floodlights illuminated a huge dish, twenty-some feet in diameter, which at that moment looked like the pride of Goldstone.

"There she is, David," he said with amazing reserve.

I mumbled a wow or a gee or similar.

"It's just a leetle one," he said, "but it'll hit the moon all right."

After fumbling a moment with his coat-hanger "lock," Jack stepped into Building C.

"C'mon in here and get warmed up."

I told him I'd be in in a minute and walked over to the dish. It was held 15 or 20 feet in the air by two huge, steel pipes buried in several yards of concrete. In the glare of the lights I could see what looked like an automobile differential welded to the top of the supporting pipes, and on this was mounted the aluminum and chicken wire dish. A huge counterweight balanced the affair. It occurred to me that all Jack needed was a beanstalk and he could have convinced the "Twilight Zone" producers that he had stolen the giant's sieve.

"C'mon in here. You'll freeze yourself out there."

Building C hadn't warmed up much, but Jack was rubbing his hands over the kerosene stove. He pointed to several, orange-crate supported benches which bulged with equipment.

"That's the deevice."

I looked at the collection of commercial, home-brew, and bread-board gear.

"Isn't that a sight?" he asked.

I had to agree that it was.

"Sammy ought to be on right now. Soon as everything warms up we'll be hearing *moonbounce*."

I looked at the equipment. A commercial power supply with controls completely foreign to the ordinary ham (me.) A rack full of what I think were filters of various kinds. The only recognizable object was a *BC 453* surrounded by a dozen tubes and i-f cans to "get the frequency down to earth."

Jack bent over the receiver, pointed to a spot on the dial, and said that was Sammy's frequency. He rocked the receiver dial back and forth, squealed the Q-multiplier a couple of times, and adjusted the parametric amplifier power supply.

"I don't hear him," he said with mock incredulity. "I can't understand it." He looked at me as if he expected me to come up with a solution.

"I know," he said, "we forgot to point the *thing*." He laughed at his joke and pushed the warped, coop door.

"You tune and I'll aim," was his parting shot.

I moved to the door to watch him point the antenna. When he had it untied and free-swinging, he aimed it roughly at the moon, then climbed a step ladder at the base of the mount to check his compass readings against his pocket-chart. After several trips up and down the ladder, several looks at the chart, and innumerable sightings through the telescope, he tied everything down and came back inside.

"Hear him yet?"

I had neglected to tune. Getting the dish on target was a fascinating operation. Jack rocked the *453* dial back and forth. He squealed the Q-multiplier. He looked at his watch.

"Be about a minute before the moon catches up with the dish," he said, and went back to tuning. We listened to the roar and hiss come out of the small speaker. Jack boosted the volume and started a rustic tape recorder. He again looked at his watch.

"Maybe the moon's running a little slow tonight," he said, and then laughed.

UHF noise, tube noise, and Q-multiplier squeal filled Building C and much of the empty countryside.

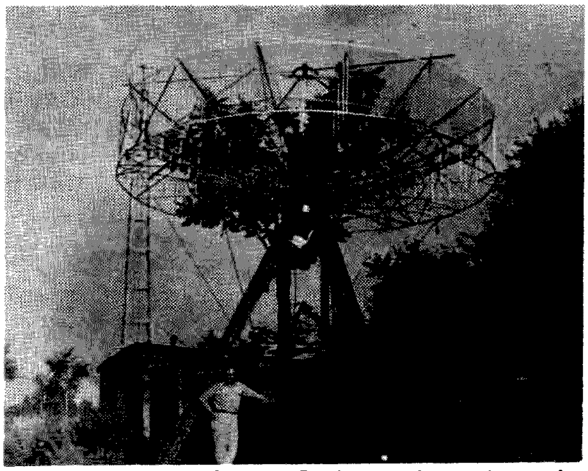
"Hear anything, David?"

"No," I said.

"You don't?"

"No."

"Well, I don't either," said Jack. "Must be something wrong."



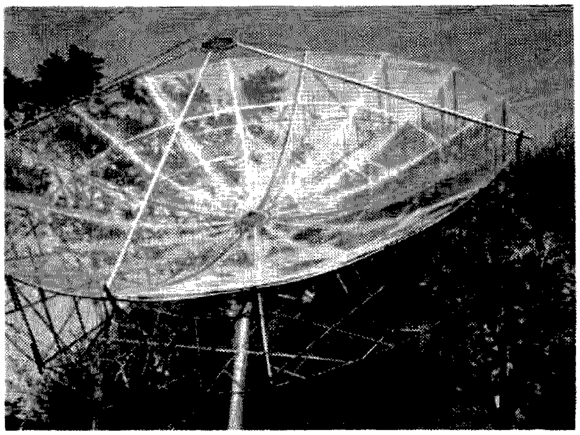
We went outside. As Jack gently nudged the dish, I sighted the moon through the telescope.

"Put the cross hairs on the leading edge of the moon."

I did as I was told. The cross hairs were just off center. At that moment, from Building C, came a low, beat note. It went off, then came on again.

"There's old Sammy. We found him," said Jack. "I knew he was there. Just takes a bit of looking."

He was there. And loud. From the Rhododendrom Swamp of Waltham, Mass., to the moon, to the semi-wilderness of Dorset, Ohio



in about two seconds. Quite a trip at 1296 megacycles. And there I stood on a ladder under a chicken-wire dish listening to the wavering note.

"He's not very loud yet," said Jack.

I thought he was at least S-9 on any conservative meter.

"You got it on the leading edge?"

I checked the moon in the cross hairs.

Jack tied the antenna down while I kept him sighted on target. We went inside to listen to the loud series of dashes which signalled another success for Jack and Sam. After we listened for a few minutes, the moon moved on and the signals faded out. Jack rewound the tape recorder and lifted off the tape.

"That was a pretty good test," he said with rare modesty. "Let's go in and play this to Sammy."

The familiar sideband kilowatt at W8LIO was warmed up (as usual) and set to 7250 kc for the schedule with W1BU/W1FZJ.

"Hello, Sam; Hello, Sam; Hello, Sammy. This is W8LIO calling you. W1BU, this is W8LIO."

Immediately came the answer.

"W8LIO, this is W1BU."

This standard reply caught Jack off guard.

"Who's this?" he asked.

"This is Lew, W1ICP."

"Is Sammy there, Lew?"

"He's coming in now."

"OK. I'll play my little tape for you boys if you're ready."

Jack started his battered tape recorder, a twin of the one in Building C. He plugged the output of the recorder into the *20-A* and the *4-1000* linear lighted up with what, moments before, had been a 1296 mc signal. After playing a minute or so of the loudest portion of the tape, Jack picked up the microphone.

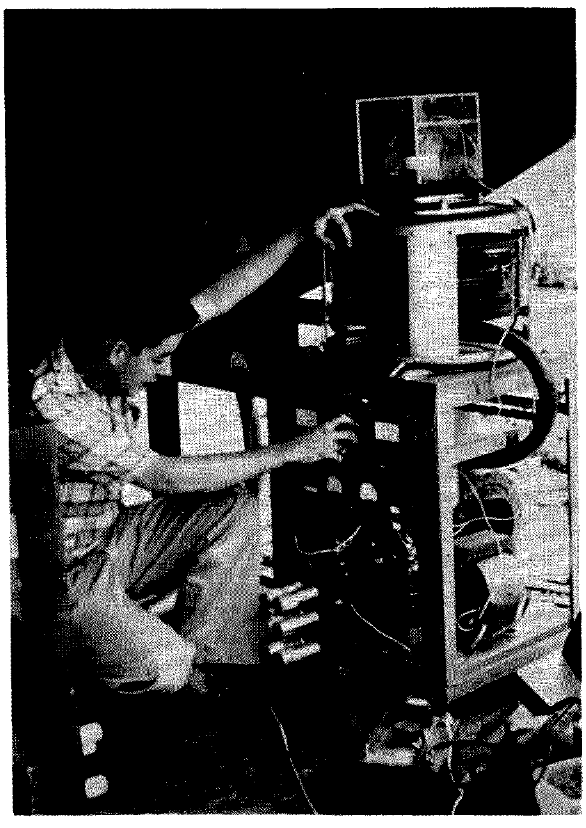
"I guess my receiver is working OK, eh Sammy?"

"It sounded pretty good tonight," said Sam. He's not noted for superlatives.

"What did you think of it, Lew?" asked Jack.

Lew, it seemed to me, sounded a little breathless. If so, it was understandable.

After the schedule was affirmed for the following evening and W1BU had signed off, an AM station came on the frequency complaining about the nuts who imitated Russian jamming signals. I suppose Jack's tape recording did sound a bit like a jamming station. It occurred to me then that hams are in two general categories: the pioneers and everybody else. For a moment that night, I was among the pioneers. . . . W8GUE/6



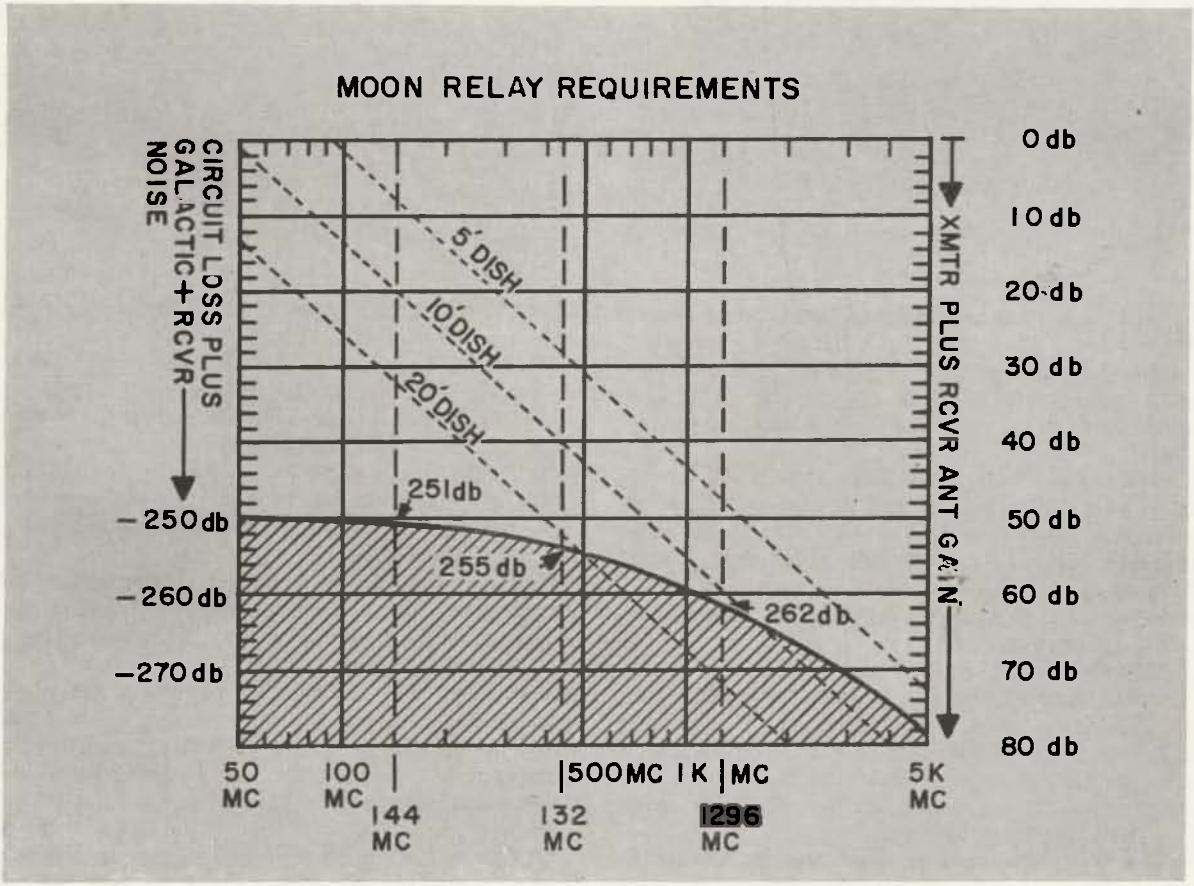
Fred Collins W1FRR tuning W1BU

More About Club Subscriptions

Same message as last month. Clubs subs are only $2.50 each in groups of five or more subscriptions. Please list name, call and address. Subs must all start with next published issue. All back issues must be ordered separately at 50¢ each. Clubs must be absolutely bonafide, having been in existence for at least ten minutes before ordering group subscriptions.

Moon Relay Requirements

Bill Ashby K2TKN
Box 97
Pluckemin, New Jersey



Given: Receiver sensitivity of —175 db below 1 watt.
Transmitter power output of 300 watts on CW or SSB.

Add: Actual gain in db above a dipole of both receiving and transmitting antennas, less feedline loss.
Place this gain on chart on the frequency you are using. The number of db this extends into the shaded portion gives you the signal/noise ratio.

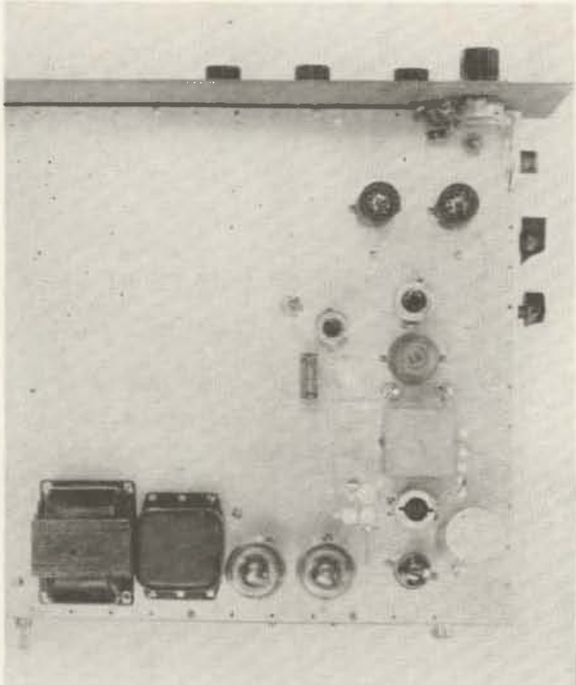
Faraday Shift and other fading: 10 db minimum

Doppler Shift: 3.5 cycles per megacycle maximum

Why? If you can get 10 db into the shaded portion you can talk to other amateurs up to 12,000 miles away 365 days of the year!

This is based upon recent, extremely accurate, moon circuit loss info and agrees with every actual bounce we know of . . . W4AO, W1FZJ, W2NLY, WφETJ, etc. With the biggest 50 mc antennas you could get up (20 db) it would take 3 KW output from the transmitter. On two meters (23 or 24 db antenna) it takes a full KW output (not input). And this just gets the minimum detectable signals.

. . . K2TKN



Simple Super Sideband

Angel Fernandez W2NQS
2017 Homechest Avenue
Brooklyn 29, N. Y.

SOME like single sideband and some don't as the saying goes, but like it or not this sideband exciter can give you a taste of sideband operation with a rig in the Cadillac class at a price more in line with "compact" quality.

Built around the new RCA type 7360 beam-deflection tubes, it gives 60 db or more of carrier suppression and more than 40 db suppression of the unwanted sideband. These figures decome all the more astonishing when you note that it's a phasing-type exciter rather than a filter rig.

Before you rush into the shack and start slinging solder, though, please note that this unit as described is an exciter *only*. Its output is 1 volt peak-to-peak at 1700 kc. It still needs a mixer to get to your favorite band, and this mixer can be combined with a VFO to give you bandhopping ability.

The complete exciter is shown in block-diagram form in Fig. 1. RF generated by the carrier oscillator is fed into a phase-shifting network and from there into a pair of 7360's. Audio from the mike, meanwhile, is amplified and phase-shifted separately. Each audio channel is then phase-split to get a push-pull signal, and these two push-pull audio signals are also fed to the 7360's.

To those familiar with phasing exciters, this block diagram won't look too different from the conventional type. Just a different kind of balanced modulator, that's all. But therein lies the secret of success, for adjustment of the 7360 balanced modulator is simple and straightforward, unlike adjustment of the conventional diode-ring or lattice modulators. What's more, the balance adjustments, once made, don't creep and consequently require little readjustments later.

One note about the 7360 at this point. Like all cathode-ray tubes (and that's about what it is, although it doesn't look much like the usual CRT) this bottle doesn't like stray magnetic fields. They play hob with its operation. Therefore, it must be kept as far as possible from all such chunks of iron as transformers and filter chokes.

Keeping this point in mind, construction is straightforward. The schematic diagram is shown in Fig. 2. You can use the chassis layout shown in photo or fit it into your own space; however, if layout is changed be sure to keep all components and wiring associated with the plates and the deflecting electrodes symmetrical. Extremely small differences in stray capacitance can give you balance troubles later on.

Construction is simplified by use of Vector turret sockets, permitting each section to be wired separately and installed in the chassis after wiring is finished.

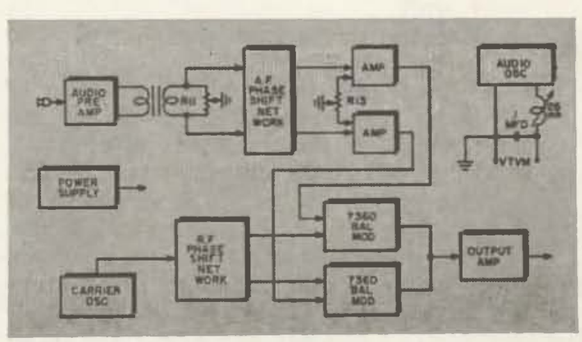


Fig. 1

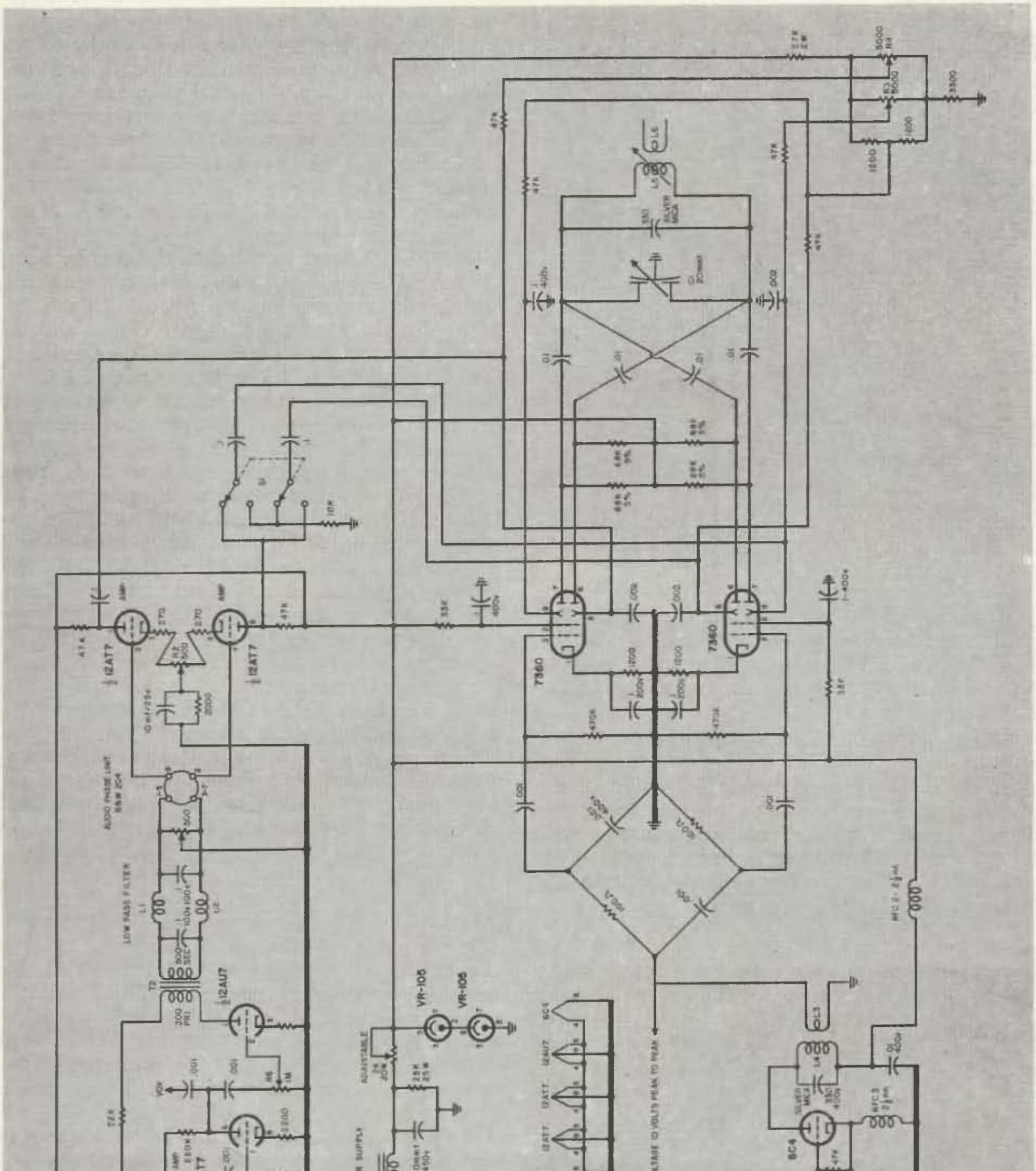
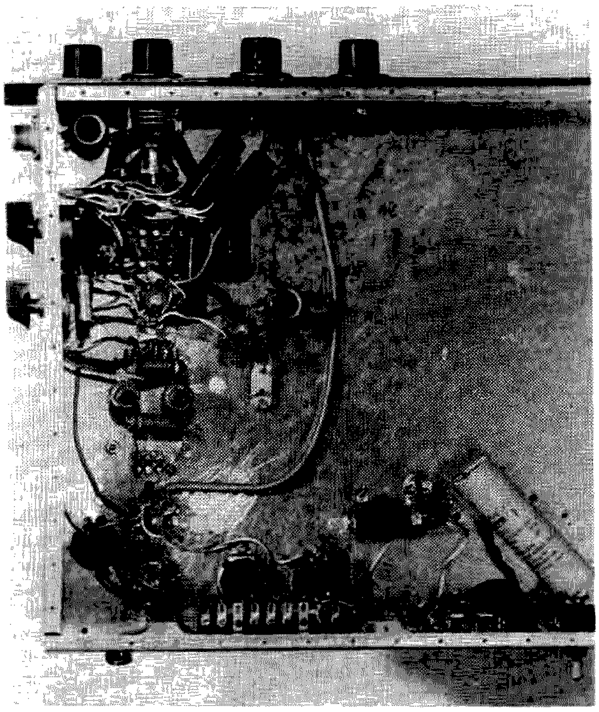

PRE-AMP
12AT7
12AU7
LOW PASS FILTER
AUDIO PHASE UNIT
7360
7360
POWER SUPPLY
VR-105
VR-105
115 AC
INPUT VOLTAGE 10 VOLTS PEAK TO PEAK
6C4
1200 KC CRYSTAL

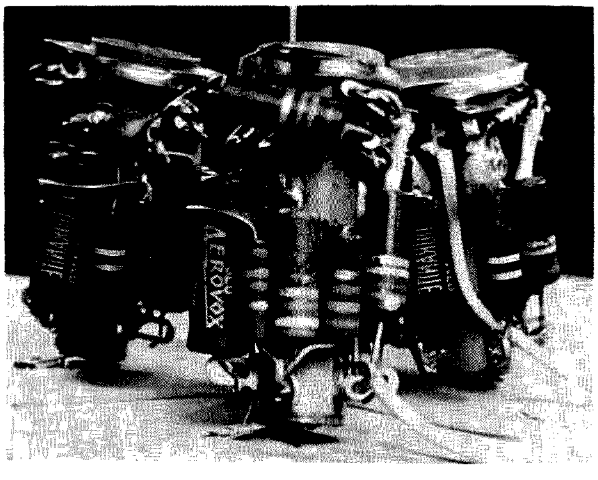
Fig. 2



Once built, the rig must be adjusted. Initially, you need a receiver tunable to 1700 kc, a VTVM with rf probe, and an af oscillator. Operational adjustments are made using the shack receiver only.

Initial adjustment of the exciter is as follows:

1. Check the power supply to make certain its output is humfree. One way of doing this is to connect a pair of phones in series with a 0.1 mfd 600-volt capacitor from B+ to ground (CAUTION: Turn off power first) and listen.



Use of vector turret sockets greatly simplifies the construction of this exciter. This 7360 balanced modulator looks more complicated than it is due to the artistic double mirror photo by W2QDM who wanted you to see all sides at once.

2. Adjust R5 until the VR tubes glow. Make certain that they remain lit with the exciter operating; if they go out, readjust R5.

3. Resonate the low-pass filter at 3 kc using an af oscillator as shown in Fig. 5 and adjusting for maximum indication on the VTVM.

4. Adjust LA until measured voltage from pin 6 of the 6C4 to ground is–18 vdc.

5. Apply a 1 kc signal to MIKE input and monitor voltage at pin 6 of V3. Adjust R6 for a reading of 1 volt RMS (2.8 v P-P). Mark setting, return to zero.

6. Using the receiver, locate the carrier near 1700 kc. Unbalance R3 and R4 and peak the signal with receiver tuning. Adjust R3 and R4 in turn until signal nulls out. When adjustment is correct, the carrier will be completely gone and cannot be located even with BFO.

7. With 1 kc signal at MIKE input, adjust R6 until receiver S-meter indicates approximately S-8. You should hear a 2-kc tone. With receiver selectivity in sharpest position, tune higher in frequency until S-meter peaks. Place SIDEBAND SELECTOR switch in position 1 and adjust R1 and R2 in turn to null out the signal. Place SIDEBAND SELECTOR switch in position 2 and signal should return.

8. Return switch to position 1 and *slowly* tune 2 kc lower in frequency until signal is again peaked. Place switch in position 2 and touch up adjustments of R1 and R2 if necessary. These adjustments are something of a compromise, but even at worst you will get something like 40 db suppression of the unwanted sideband. Adjustment is now complete. Feed output of exciter to mixer and amplifier of your own choosing and BCNU on the bands.

9 Mc Output

Since many of you will be wanting to have the output on 9 mc, you will want to know what changes are necessary. The oscillator should have a 3 uh coil (L4) made up of 11 turns of #26 enam. on a National XR-72 form with a three turn link on the cold end of the winding. Change the crystal to a 9 mc crystal. The plate condenser should be changed from 330 to 100 mmfd. The two .001 condensers in the bridge circuit of the oscillator output should be changed to 175 mmfd.

Parts List

R1-R2—500 ohms linear Ohmite CU-5011 2W
R3-R4—5000 ohms linear Ohmite CU-5021 2W
C1—20 mmfd per section differential variable Johnson 160-311
RFC—2.5 mh National R50
L1-L2—TV linearity coil, Miller 6315 4-30 mh
L3—4 turns #26 enam. on cold end of L4
L4-L5—43 turns #26 enam. on ¾" diameter form, National XR-72
L6—4 turns wound on center of L5

. . . W2NQS

73 TESTS

the Knight-Kit G. D. O.

Stephen Abrams W2OKU

By now the reader of 73 Magazine must be rather familiar with the subject of grid-dip meters. The circuits are basically similar; the sizes of the "boxes," likewise; the frequency ranges, ditto. Why, then, the great number of articles? There are at least two reasons. The first is simple. Give the reader a sample of what is available in specifications and equipment. The second is only slightly more subtle. Occasionally a manufacturer will provide a "something" in his equipment, either making its use more convenient or providing a novel usage, that may make it more worthy of consideration by the buyer. This kit, happily, satisfies both reasons.

Price: $22.95
Time for construction: One evening
Range: 1.5-300 mc

Red	1.5-3.5
Violet	3.4-8.5
Blue	8.2-20
Orange	19 -45
Yellow	45 -110
Green	105 -300

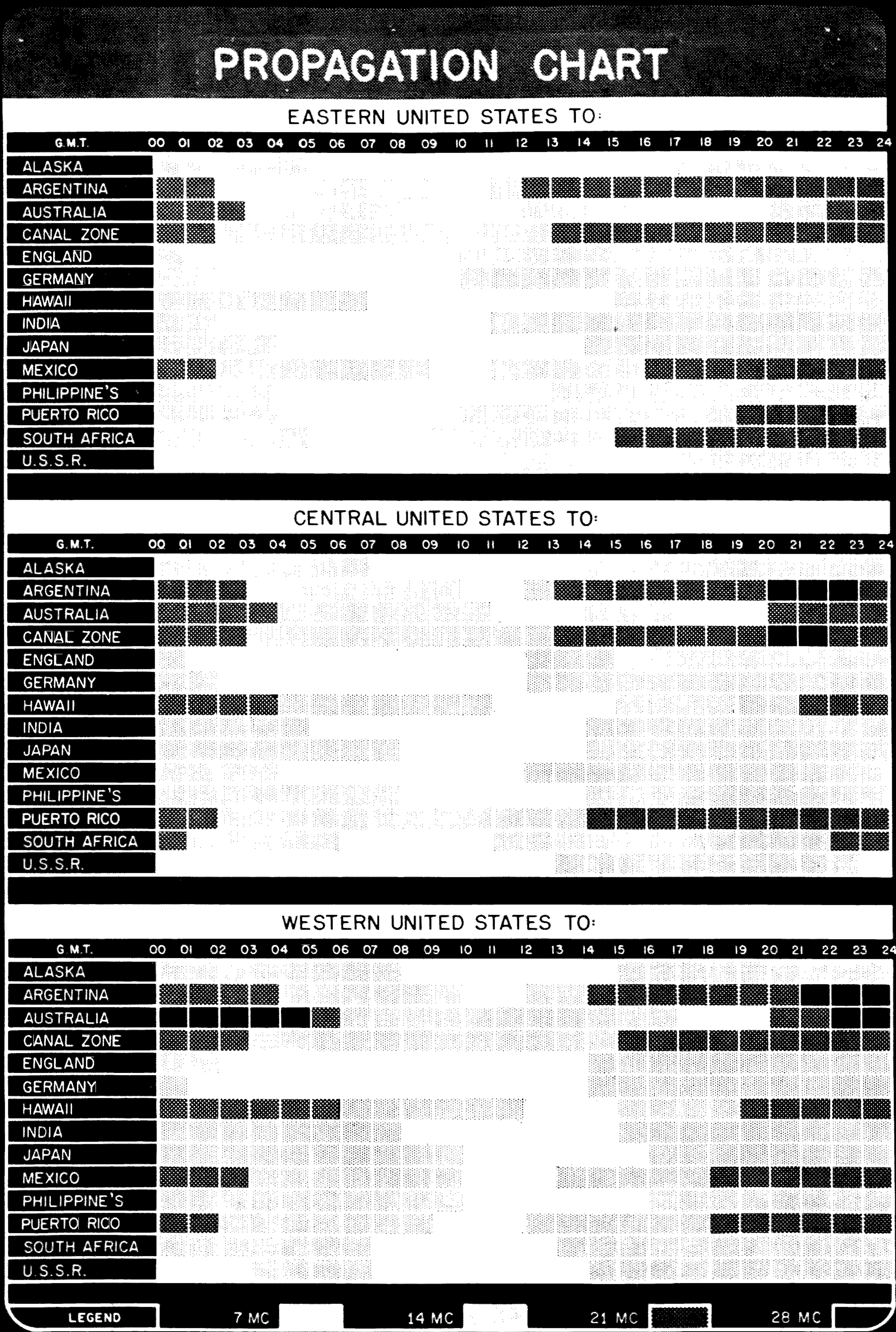
Input power: 105-125 volts, 50-60 cps, at 3 watts

Uses: Determine tuned circuit frequency
Determine circuit Q
Measure inductance
Measure capacitance
Phone and CW monitor
Crystal tester and market generator
Signal generator
Neutralization adjustment
Parasitic and harmonic checks
Coarse frequency measurement

The Knight G-30 lists for $22.95, and is available only in kit form. It covers the frequency range from 1.5 to 300 mc in six bands as listed in the specifications column. The case is of satin finished aluminum and occupies a space of 6¼ x 3⅛ x 1½ inches. The completed unit is quite light, weighing in at 1 lb. 10 oz. This, combined with the serrated dial extending beyond the case, permits easy one-hand operation.

In any grid-dip meter a point of major interest is the frequency scales. In this kit the prewound plug-in coils which determine the frequency range have been color-coded to correspond to similar coloring located on the case below the markings on the clear plastic tuning dial. If you have ever used a GDO and suddenly found yourself wondering which scale should be read you wuold appreciate this feature. The scales are clearly marked on the

(Continued on page 37)


PROPAGATION CHART
EASTERN UNITED STATES TO:
CENTRAL UNITED STATES TO:
WESTERN UNITED STATES TO:
G.M.T.
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PUERTO RICO
SOUTH AFRICA
U.S.S.R.
LEGEND
7 MC
14 MC
21 MC
28 MC

Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

The bands listed are MUFs and a higher band will not work for the time period listed. Lower bands will work, but not nearly as well. Times are GMT, not local time.

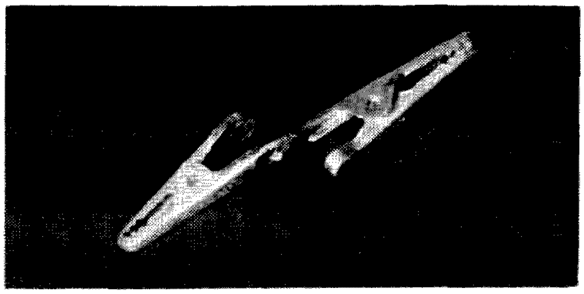
These charts are to be used as a guide to ham load openings for the month of May, 1961 to the various countries listed. I will be interested to hear of your results in using these charts and to know what other areas you might wish included in future charts.

Advanced Forecast: May 1961

Good 6-7, 16-18, 20-31

Fair 1, 3-5, 8, 12-15, 19

Bad 2, 9-11



Quick and Cheap

Experimenters will find a miniature double clip, made by soldering two of the smallest alligator clips together end to end, an almost indispensable aid to breadboard construction of electronic projects. Using the miniature twin-clip eliminates soldering of components in early assembly stages, and allows instant substitution when determining exact parts values for experimental projects. Cost of the midget clips used to maek the tiny twin-clip is 7 cents each in individual quantities, or 44 cents for 10—making the twin-clip's cost negligible in comparison to the cost of parts saved through its use. . . . K5JKX

(G.D.O. from page 35)

knob with little chance for parallax as there is only small clearance between the scale and hairline. The quality and quantity of the dial markings are suitable for the ranges presented. A particularly desirable feature of this unit is the inclusion of a movable hairline. This permits the exact setting of a particular frequency and a higher than normal frequency accuracy for the immediately surrounding region of the dial. The data plotted in Fig. 1 was taken by setting the hairline to a measured whole-number frequency near the center of the range tested, and varying the dial setting from that point. Setting the hairline parallel to the length of the chassis, as is done in the initial calibration, results in frequency accuracies comparable to other units in the same price range.

The stability of the unit with changes of line voltage was found to be almost independent of operating frequency. The average shift was 190 cps/volt of line variation. As this variation was measured for voltages from 90 to 130 vac (let's hope yours is never worse), ac line stability should be no problem.

Construction of the meter proved to be quite easy as the instructions are almost childishly simple. Care must of course be taken in wiring the rf circuits. The unit was built in the course of one evening with no perspiration appearing on the brow of the assembler. It is pleasant to be able to state that it worked immediately; due credit must again be given to the instructions. It is worth noting here that the manual accompanying the equipment includes, in addition to constructional details, complete descriptions of how to use the GDO in all the applications mentioned in the specs column. Also included is a reactance-frequency nomograph (easy to use) handy for some of the applications: inductance and capacitance determination.

Electrically the circuit is one which has almost become standard. A 6AF4A UHF triode is used as a Colpitts oscillator with the resonant circuit made up of the plug-in coil and dial driven variable capacitor connected between grid and plate. Provision for the use of headphones for audio monitoring is made with a panel jack which simultaneously removes the indicating meter from the circuit. Use as a wavemeter is accomplished by setting the unit for minimum sensitivity which removes supply voltage from the tube, permitting it to act as a tuned diode detector.

All in all the G-30 is a satisfactory example of a device which should be present in every ham shack. As to why you should have one in your shack, I refer you to the list of uses printed here and to the Radio Amateur Handbook (ARRL).

. . . W2OKU

Economical Custom Resistors

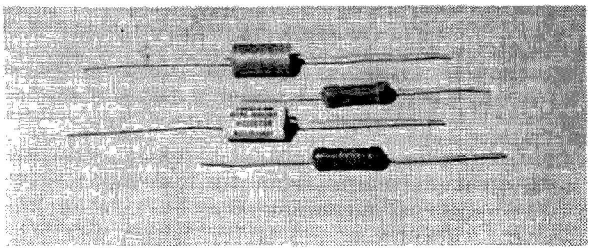
A Low Cost Approach to the Precision Resistor Problem

Roy E. Pafenberg

THE experimenter, faced with the problem of obtaining precision or high stability resistors, has a variety to choose from. Accurate wire-wound and deposited film carbon resistors may be purchased in many stock values and packaged in a number of configurations. In addition, other sophisticated types are available to suit those with exotic tastes and thick wallets.

Two complications arise which limit the application of these components in the general run of home construction projects. First, the cost is high, ranging from under a dollar for enamel insulated, carbon film types to over $15.00 for the higher value wire-wound resistors. The second problem is that required values, in the desired tolerances, may not be stocked. This is true despite the wide range of listed values. For example, the catalogs list nearly 500 stock resistance values in the IRC and Texas Instrument lines of encapsulated, deposited film resistors.

The usual answer to the problem of prohibitively expensive components, at least for the amateur or experimenter, is to turn to military or commercial surplus stocks. While this answer is still valid, the chances of obtaining a high percentage of required precision values from these sources are minimal.



Before and after view of altered resistors. Carbon film unit is protected by nail polish while the wire-wound resistor has a layer of plastic tape applied.

There is a simple, low cost solution to this problem but, before going into the methods and procedures, a look at the basic characteristics of these components is in order.

In general terms, a precision resistor is a resistor that may be manufactured to very close resistance tolerances, ranging from a small fraction of one percent to about two percent deviation from their nominal value. Such resistors will maintain this degree of accuracy for long periods of time and under adverse conditions of temperature and humidity. Any variation of resistance with respect to temperature is small and, when the temperature is restored to normal, the resistance returns very close to the original value. Each of the types mentioned above fall in this general category.

The conventional precision wire-wound resistor is simply a length of suitable resistance wire, wound on a bobbin or other form, and provided with terminals or leads. Many types are available and the finished resistor may or may not be encapsulated. These resistors may be manufactured to extremely close tolerances and are relatively expensive.

The carbon film resistor consists of a ceramic rod with a layer of carbon combustion products deposited on the outer surface. Termination is effected by crimping end caps and leads on either end of the rod. The resistance is often brought to final value by cutting a spiral groove, through the carbon, for the length of the rod. In this event, the thickness of the film and the pitch of the spiral determine the resistance. The finished resistor may be protected by enamel insulation or may be potted in casting resin. The basic manufacturing process is low in cost and wide tolerance, film resistors are becoming common in all types of equipment. Inspection and testing to close tolerances increases the cost considerably. Even so, they are the least expensive of the precision resistor family, with some types of 1% tolerance available at under sixty cents each.

A review of experimental applications of precision, high stability and/or low noise resistors is in order. Requirements for such resistors fall in four general categories:

1. Precision, high stability resistors of predetermined value and tolerance.
2. Precision, high stability resistors of un-

determined value, the resistance of which must be adjusted, in circuit, to meet known standards of performance.

3. Two or more precision resistors for use where the absolute resistance value is of minor importance, but where the resistance relationship of one to the other must be controlled to a high degree of accuracy.
4. Resistors of the precision type for use where the absolute resistance value is of minor importance but where the characteristics of high stability and low noise are required.

The cost of new stock, carbon film and wire-wound precision resistors is often prohibitive, however both types are readily available on the surplus market. Fantastically low prices are the order of the day. For example, TAB of New York lists them at 35 for $.99, LEKTRON of Chelsea, Mass. at $3.00 per pound and Brooks Radio and TV Corporation of New York at 40 for $1.00. Both the carbon film and wire-wound resistors, of the un-encapsulated types, may be changed in value to meet specific requirements. The job is relatively simple and pays off in dollars saved.

The first step in producing custom resistor values is to obtain an instrument of sufficient accuracy to satisfy the application at hand and this requirement can vary widely. In the

Wire-wound resistors respond to similar treatment. Preset the bridge to the desired resistance value and connect one end of the resistor to the bridge. Unwind resistance wire from the free end of the resistor, passing it through the other terminal of the bridge, until the bridge indicates balance.

Carbon film resistor is quickly raised to desired value by removing a portion of the carbon film with sandpaper.

simplest case, where the value of a resistor must be adjusted to achieve known standards of equipment performance, only the test equipment normally required for maintenance of the device would be needed. In other cases, where stability rather than extreme accuracy is the objective, a good ohmmeter may suffice.

A resistance comparator bridge, such as described in the December, 1959 issue of Radio-Electronics, is a low cost solution if very close tolerance, matched resistors are required. In the article, "Match Resistors Fast," I. Queen gives construcion details for a very inexpensive but very accurate instrument. As a matter of fact, the money saved on a couple of matched pair requirements will probably cover the cost of the parts to build the bridge and a reasonable stock of surplus, carbon film resistors.

However, for those applications where absolute resistance value is of importance, an accurate resistance bridge is the best answer. These instruments, though simple and widely used, are relatively expensive. Substantial savings can be obtained on the surplus and used equipment market but the cost is still high. If a bridge is not available, it should not prove too difficult to secure the use of one for the short time required. Suggested sources are the larger distributors, trade schools, public schools and private industry.

Enamel insulated, carbon film resistors are very easy to adjust to any reasonable, higher resistance value. It is recommended that the initial value be at least half the desired value

to avoid stability problems and excessive reduction in the wattage rating of the resistor. To change the value of the resistor, mount the unit on the bridge terminals and adjust the bridge to the desired final resistance value. Loop a strip of fine sand or emery paper over the body of the resistor and sand lightly until the bridge indicates balance. Proceed cautiously to prevent undue heating of the resistor and to avoid overshooting the desired value. This method is foolproof and is both quick and accurate. The photograph shows the procedure and it is as simple as it appears. A coat of nail polish, in your favorite shade, will provide moisture protection and give a custom appearance. Marking decals may be added for a truly custom job.

Wire-wound resistors respond equally well, although the technique is slightly different. The resistor selected must be of higher resistance than the desired value and the reduction in wattage rating will be in direct proportion to the percentage of resistance wire removed. Expose the resistance winding, clip and then unwind a portion of the winding. Set the bridge controls to indicate the desired value and connect the undisturbed terminal of the resistor to one terminal of the bridge. Continue to unwind the resistance wire and slide the wire through the other terminal of the bridge until balance is indicated. Enamel insulation can be scraped on the terminal post to make contact until the balance point is approached. Portions of wrapped insulation may be removed in a similar fashion. When the balance point is localized to a few inches of wire, carefully remove all the insulation in that area and arrive at the final balance point with the wire securely clamped in the terminal post. Mark this point, slide a length of insulating tubing over the bare wire, and rewind on the bobbin. Carefully solder the resistance wire to the terminal and measure the resistance to insure that nothing has gone wrong. A layer of plastic tape around the bobbin will provide protection and give a commercial appearance.

The photograph shows the method used. The time required to adjust a resistor to the desired value is less than that expended in reading a description of the method. The remaining photograph shows before and after views of both carbon film and wire-wound units.

The techniques outlined above will provide, at nominal cost and little effort, precision resistors for experimental applications and will permit their use in projects where their cost would normally be prohibitive. Improved and predictable performance of critical circuitry are two of the major advantages gained.

Calibrate VOM AC Scales

The average VOM can be checked for accuracy quite easily on DC and OHMS scales (using mercury cells and precision resistors), but the AC scales are usually a problem. Trying to calibrate the instrument using the line voltage as a standard is generally a waste of time, since variations are so great and unpredictable.

For less than twenty dollars, you can purchase a device that will act as a stable regulated supply for small instruments and also serve to calibrate your VOM within one half percent! Select a Raytheon Voltage Regulating Transformer, according to the wattage of the other instruments you want to power. I chose the 30 watt model, and use it to power my VTVM and my scope calibrator. The output of each of the available transformers is 115 volts, RMS, ½% tolerance.

To calibrate your VOM, simply connect the test leads to the transformer output socket. A word of caution: the output of the transformer is not a sine wave, and cannot be used to calibrate peak-to-peak VTVMs. Confine your tests to RMS sensing instruments, such as VOMs, and you'll be rewarded with accurate and dependable readings.

. . . Bentley

Ohms by the Yard

Jim Kyle K5JKX/6

ESPECIALLY in the breadboard stages, a rig often requires a high-resolution voltage divider or potentiometer capable of being set within less than half a degree—or in more usual language, capable of being adjusted to within a fraction of a volt yet having an overall range measured in tens of volts.

A case in point is a 1296 mc parametric amplifier recently described elsewhere, which uses a surplus 2K21 as the pump-frequency generator. This reflex klystron is electrically tuned, and adjustment of the repeller voltage must be exact.

An expensive answer to this problem is a 10-turn poteniometer. This gadget, unknown to many hams but common in the analog-computer field, requires 10 full turns of the input shaft to travel from one end of its range to the other. You might call it a potentiometer with bandspread. The price puts quite a spread on the bank balance, too—it costs a minimum of $10.

Here's a less-expensive device which does the same thing. It can be substituted as a unit anywhere a 10-turn pot is specified, but even if all parts are purchased new will cost you less than $6. The $4 saved will more than pay for a year's subscription to 73.

As shown on the schematic diagram, this unit has a total resistance of 100,000 ohms. It was developed for use with the 1296 mc paramp previously mentioned. To adapt it to any other total-resistance value, simply adjust all resistance values in proportion.

Basically, this gadget is a switched voltage divider, one leg of which is an ordinary TV-type potentiometer. Each switch position moves the potentiometer one-tenth of the way up its range, effectively dividing shaft motion by 10 as a result. Thus, with the switch in position 1 and the potentiometer dial set at 20 percent of full rotation, the wiper arm is 2 percent of the way up the total range. In the same switch position with the pot all the way up, the wiper is effectively at the 10 percent point. Moving to switch position 2 and

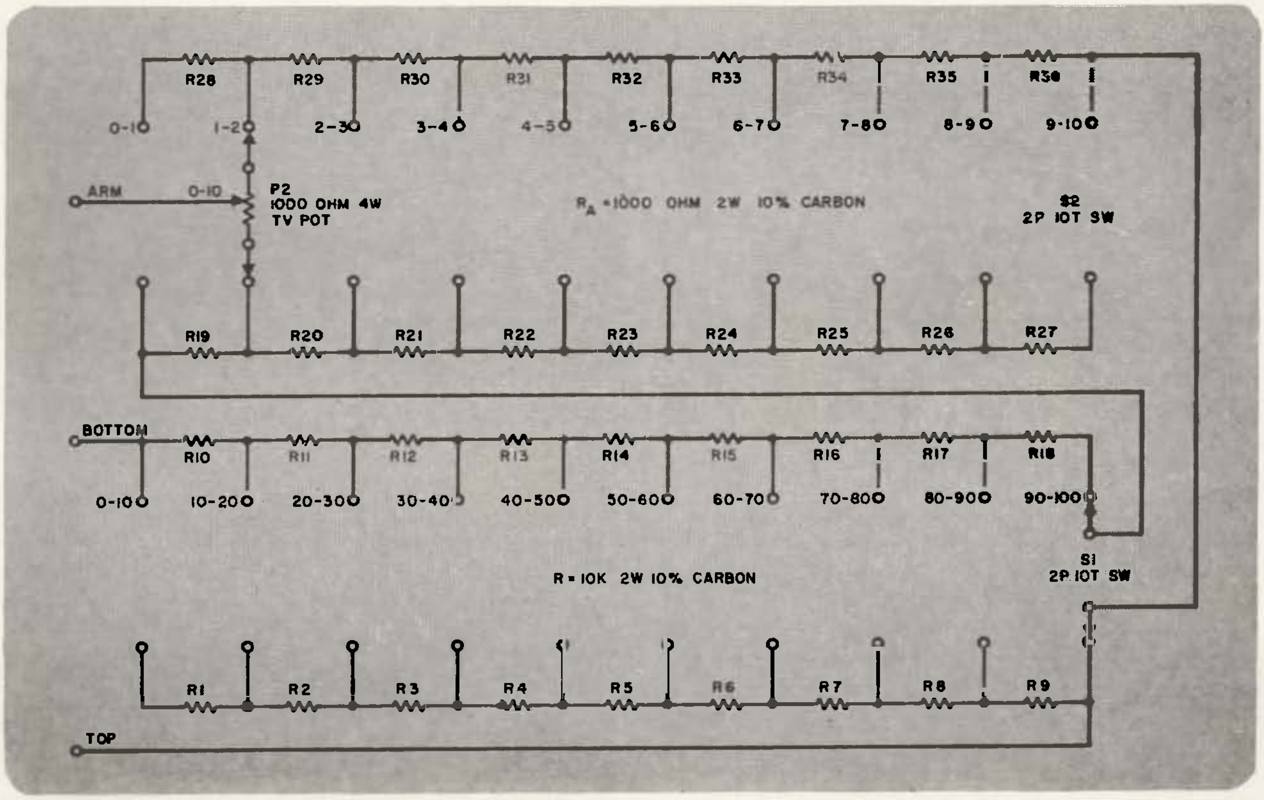


Fig. 2

setting the pot at zero maintains the 10 percent point, while opening the pot to 20 percent on position 2 gives you an effective 12 percent of total range. In this manner, the entire range is covered.

The idea can be expanded by adding one more switch and 18 more fixed resistors as shown in Fig. 2 to give the equivalent of a 100-turn potentiometer at the same cost as a standard 10-turn unit. This amount of resolution would allow you to choose an output voltage between say 50 and 150 volts to within 0.01 volt if desired (a diagram of such a supply is shown in Fig. 3.) For most purposes, though, the unit of Fig. 1 will suffice.

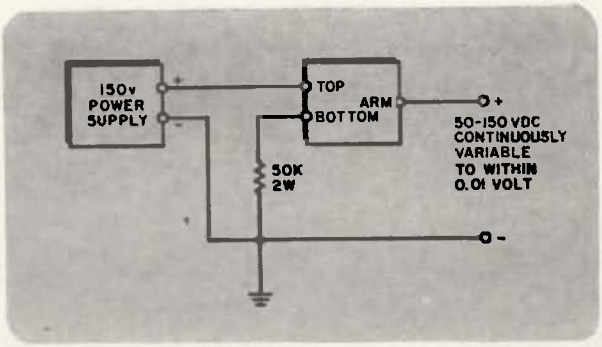
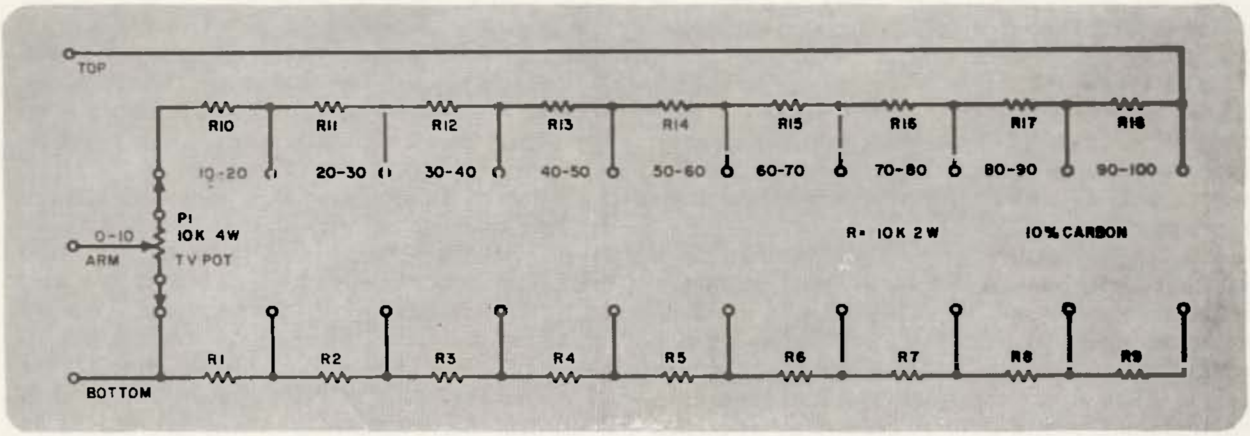


Fig. 3

Fig. 1



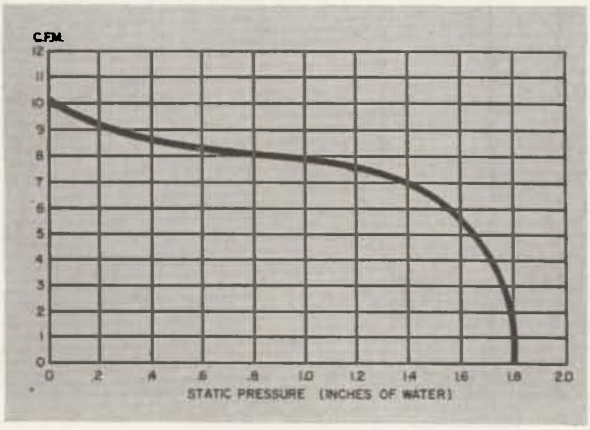
Blowers: Facts and Figures

Melvin Leibowitz W3KET
220 West 4th Street
Wilmington 1, Delaware

FORCED air cooling in ham transmitters; virtually unheard of a decade ago, is now becoming commonplace. It is the purpose of this article to help the home-brewer select the proper blower as information on this subject in contemporary literature is virtually non-existent.

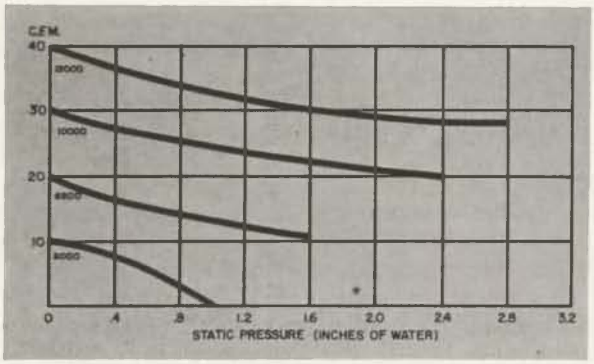
There are two general situations that require forced cooling. The first is where a lot of heat is produced in a confined space as in a high power final amplifier. Short lead construction and thorough shielding required in modern construction seriously restricts the natural flow of air and something has to be done to get the air moving again. This problem can be solved simply by placing a 3 or 4 inch fan at a strategic place in the enclosure so that it will stir up a breeze.

The second situation can not be treated so lightly. This is where external anode tubes



such as the 4X250, PL172, 4CX1,000, etc. are used. These tubes must have a definite amount of air blown through their plate structure if normal tube life is to be expected. In-as-much as these tubes are expensive, tube life becomes a serious consideration and the ham designer will want to be sure that he is supplying enough air.

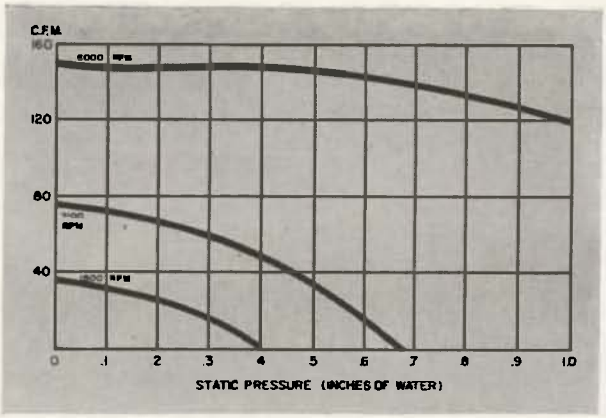
Most hams will obtain their blower from military surplus. Very often they will not be rated in terms of air output but the motor speed and blower size are almost always given. The charts and tables given here will help you to determine the output of your blower. Blowers come in several different sizes according to the wheel diameter. These range from a number 1 to number 3 as shown in Table 1. The size of the blower is usually stamped or moulded into the side of the housing. Table 1 also lists several common speeds for each size wheel and the corresponding output. You can still determine the output if your blower speed is not listed by interpolating between the figures given. This is not strictly accurate but close enough for all practical purposes. These figures are typical but not necessarily exact as the thickness of the wheel also influences the output. It is most important to stress that the figures in Table 1 are for blowers working into open air, not under pressure.



The output will drop under pressure. Figures 2, 3, and 4 show the output of different size machines at various pressures.

The tube data sheet will tell you how much air is required and at what pressure. Two tubes will require twice the volume of air but the pressure will be the same as for one tube. It would be wise to allow a safety factor of at least 2 and preferably 3 as there will be some air leaks in the system and other losses.

Inspection of Table 1 shows that small blowers must turn at very high speeds in order to produce usable amounts of air. Small blowers are to be avoided for this reason if quiet operation is desired. The motor itself may be quiet but the high speed chopping of the air by the fan blades tends to set up a loud hiss approaching an effect something like a siren. There is bound to be more vibration in a high speed motor than in a slower one. For reasons of quietness then, select a slow speed machine



about 1500-3000 R.P.M.

If you intend to buy a surplus blower bear in mind that many of them are brush type motors designed for low voltage direct current. They will work on A.C. but there is a possibility of them causing QRN in the receiver. It may or may not be possible to filter them by bypassing the brushes to the case of the motor.

In summation: select the largest, slowest blower that you can fit in the cabinet. Allow a safety factor of 2 or more. Clean the rotor blades every few months particularly if your transmitter is located in your living quarters as the blades will pick up quite a bit of lint and dust. A pipe cleaner moistened in water is good for this. Be very nice to your parts supplier and he may let you select the quietest machine from his stock.

Many hams are needlessly prejudiced against forced air cooling, but if the principles set forth here are followed, dependable, quiet operation will result. . . . W3KET

Table I

Size	Speed	Output C.F.M.
1	18,000	9
1½	3,000	4
	8,000	12
	11,000	17
	15,000	23
2	3,000	10
	6,000	20
	10,000	30
	13,000	40
2½	2,750	17
	6,000	35
	9,000	52
	12,000	70
2¾	1,500	25
	3,000	55
3	1,500	40
	3,000	75
	6,000	150

How Low the Fi

Staff

ONCE a radio signal has been detected, it's still somewhat useless for our purposes until we can hear it. That's the job of the audio section in any receiver. Every receiver marketed includes such a section, and most of us pretty well take it for granted.

However, the performance of the audio portion can make or break a set's overall ability for ham usage—and some of the most highly rated receivers in recent years have fallen short in the audio department.

Four major requirements must be met for an audio section to be completely acceptable: it must have adequate gain to allow the weakest signal detected to be heard; it must have a frequency response no greater than necessary for the reception mode chosen; it must be free from fatiguing distortion; and, finally, its power output must be no greater than necessary for the intended service.

Fortunately, all these requirements can be achieved easily through homebrew modifications. Let's examine them more closely.

Gain is an apparently simple thing—but it's necessary before anything else becomes important. The audio signal present at the output of most detectors is between 1 and 10 volts, and most power output stages require a minimum of 30 volts to drive them to full output (remember that audio stages—in receivers at least—are always operated Class A and are voltage—rather than power-driven).

Testing for adequate gain is simplicity itself. Just disconnect the antenna, turn the audio gain all the way up, and listen at the speaker for the hiss of random or "white" noise.

However, a noisy first-audio stage can negate the value of this test. To check for that, pull the last *if* tube. If noise persists, your audio stage is noisy. If the noise goes away when the *if* tube is pulled, your audio section has sufficient gain.

An operational test for adequacy of gain is simply to note what position of the af gain control is used most often. It should be at about 12 o'clock when listening to a normally-modulated signal (such as on the broadcast band). If it's opened wider, you can use more audio gain even if the set passes the preliminary test. If it's not that far open, you already have too much gain and it must be reduced. We'll go into ways and means of accomplishing both a little farther on.

Much has been written about the need for limited frequency response in ham receivers, and there's not too much to add in the way of theory—but a little later we'll go into some not-too-widely-known ways of achieving the theoretical ideal.

Basically, the idea behind frequency shaping is this: telephone engineers learned long ago that while the average ear can hear sounds from somewhere around 30 cycles up to 15 or 20 kc, only 2700 cycles of this spectrum are necessary to convey the human voice. Frequencies lower than 300 cycles or higher than 3000 cycles may add to a voice's character, but they don't add much to intelligibility.

Therefore, since the bandwidth required for every form of modulation is at least partially dependent on the bandwidth of the modulating signal itself, the engineers reasoned that for best efficiency all voice communication should be limited in frequency range to the band from 300 to 3000 cycles.

While this sounds as if it applies primarily to transmitters (and it does) it also has great benefits in receivers. Even if the transmitted signal covers the full audio spectrum, it's likely to be more intelligible and less fatiguing if receiver audio bandwidth is limited to the 2700-cycle voice-communication range.

The reasons arê twofold. First, no matter how good the equipment, you'll always have some noise along with the incoming signal at the signal strengths usually encountered in ham operation. While this noise is evenly distributed throughout the spectrum, the sensitivity of your ears is not so even. Most persons show a peak in their hearing between 4000 and 8000 cycles, with the majority of individuals having the peak near 6 kc.

For this reason alone, cutting audio response off sharply at 3 kc makes an apparently drastic improvement in signal-to-noise ratio. In addition, the actual noise voltage present is a direct function of bandwidth, so by slicing down the audio bandwidth the actual signal-to-noise ratio is also increased.

The other reason for frequency shaping is somewhat more subtle. It begins with a recognition of the fact that most ham operation is under conditions described by engineers as "worst possible case." We work with incoming signals in the microvolt-and-under range, we habitually attempt to copy marginal double-hop signals, and we usually work much closer

to the MUF than do the commercials.

All of these conditions contribute to unavoidable distortion of the received signal—and much of this distortion is second-harmonic in nature. This means that, even if the original signal has a clean 300-3000 cycle bandwidth, by the time it gets out of our detectors it extends up to 6 kc—and those upper kilocycles are all highly-distorted signal.

However, if we trim back to the original 3 kc upper limit in the audio stages, that distorted portion of the signal is discarded and what we hear, while not so clean as the original, is much improved in quality.

Occasionally you'll hear theoreticians among us argue that audio frequency shaping in a receiver is useless, especially if the *if* bandpass is limited to 3 kc. You can see, however, that both the reasons cited above still exist even when *if* bandwidth is reduced—since much of the noise and the distortion are generated in the detector stage of the receiver.

These arguments lead directly to the next requirement for an acceptable audio section: that it be free from fatiguing distortion.

The fad for high fidelity (and don't be misled if you've a hi-fi buff—so is the author) has shed much new light on the question of how much distortion is acceptable in audio.

In olden days, engineers figured 5 percent distortion as a good figure. They're still using that figure in communications receivers.

However, hi-fi designers have made some valid-sounding claims that as little as one percent distortion will prove objectionable over any extended period of time.

Before going any farther, though, we'd better define "distortion," since it means not just one, but many things. There is frequency distortion, harmonic distortion, amplitude distortion, phase distortion, intermodulation distortion. . . .

Only two of these concern us primarily at this point, and only those two—harmonic and intermodulation distortion—are meant. After all, we deliberately introduce amplitude and frequency distortion when we narrow the bandpass.

But harmonic distortion and IM are the most fatiguing to listen to, and they're the ones on which we shall concentrate.

The major causes of both trace back to a single root—the attempt to get too much from a single tube. This is in the accepted amateur tradition of stretching each bottle to its limit and then some, but the result can be extremely unpleasant in this case.

When any tube is stretched past its capability, it is forced to operate on non-linear portions of its transfer curve. This means that the output signal is no longer an exact replica of the input signal. In the usual case, negative-going peaks of the output signal are slightly flattened.

The result is second-order harmonic distortion, since the waveshape becomes exactly the same as the original would be if between 5 and 10 percent of its second harmonic were added to it.

At the same time this is going on, IM also rears its head. Remember back to the front end and the product detector, and what happens when two frequencies are impressed at the same time on any non-linear device? Your overdriven audio tube is certainly non-linear, and just as you might expect, you'll get a mixing action. Assume that the original signal consisted of only two tones—500 cycles and 950 cycles. At the output, you will find the original two tones, their sum (1450 cycles), their difference (450 cycles), their second harmonics (1000 cycles and 1850 cycles), the sum (2850 cycles) and the difference (850 cycles) of the harmonics, plus the sum and difference products of every frequency listed so far (taken in pairs) and every frequency so determined. Some of these spurious outputs include 1350 cycles, 100 cycles, 200 cycles, 300 cycles, 4700 cycles, and 7550 cycles. Quite a mess from just two input frequencies, no? And the voice has not just two, but dozens of simultaneous frequency components.

While the picture may appear mighty black at this point, it's not so bad as all that. This problem fortunately, can be cured permanently in any receiver for less than a dollar.

Before going into circuitry, though, let's examine the last specification for acceptable audio: power output no greater than necessary.

You wouldn't fire up a 50-foot semi-trailer to drive the kids to school any more than you would attempt to move seven rooms of furniture cross-country in a Volkswagon, but every day similar extravagances of power are committed in receiver audio sections.

One excellent conversion article published a couple of years ago included as a major step the increasing of the set's output power from its rated two watts to 10 watts. While the procedure described was perfect, it represented wasted effort for the most part, since virtually all fixed-station ham work is carried on with less than two watts audio.

Actually, if your shack is in a normally-quiet location, a half-watt of audio will be more than ample with most speakers. The hi-fi experts, again, have proved that 250 milliwatts of *audio* power (not to be confused with the same number of milliwatts applied to the speaker, since the best speakers are only some 10 percent efficient) is enough to drive one screaming from the room. About 50 milliwatts of sound energy is the average listening level.

Audio required for mobile work is considerably greater, since the speaker in the auto must compete with engine roar, wind, and other traffic noises. There, five to 10 watts is useful. But in the fixed station, for loudspeaker operation, two watts should be suf-

ficient to allow a good safety margin of power.

Of course, if you're using phones exclusively, power requirements will be much less. In this case, voltage amplification alone is all that's necessary, since most earphones function admirably with around 10 milliwatts of power applied and almost any voltage amplifier will furnish this small power at the high impedance level of most phones.

Having completed the theoretical discussion, we're ready to embark on the second stage of our search for improved audio—the achievement of these four goals.

Taking them in order, let's look again at gain.

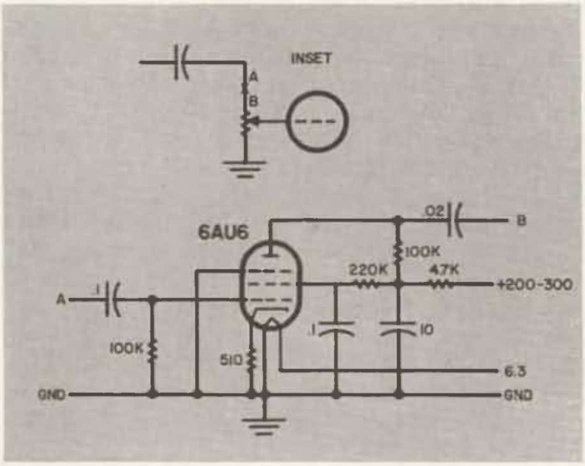


Fig. 1. This outboard audio stage will give a voltage gain of about 50. It can be added to any set suffering insufficient gain by breaking the connection to the top of the volume control, as shown, and inserting the amplifier in series.

If you need more gain, you have two choices. You can either add an outboard stage of audio (as in Fig. 1) or you can modify the existing stages for increased gain at the possible price of increased distortion. If you're also intending to reduce distortion while maintaining the same output power and introducing freqency shaping, the best bet is to add the outboard stage.

Wiring for the added stage of audio is noncritical, except that grid and plate leads should be separated from each other and from all ac-carrying wires such as filament leads. The stage should be added ahead of the volume control, thus enabling you to keep from overloading subsequent stages should you tune to an unusually-strongly-modulated signal.

If you're going to modify existing stages for increased gain, the place to start is at the plate load resistor of each tube. This is based on the assumption that you've already substituted tubes with higher amplification factors for the original bottles. If you haven't, do so. Substitutes for some of the popular audio tubes include: 6SF5 for 6J5 (requires rewiring of socket); 12AX7 for 12AU7; 6AV6 for 6C4 (requires rewiring); and 6AV6 for 6AT6. Other substitutes can be located in a few minutes with a good tube manual.

Now, increase the values of the plate load resistors. They should go up to 470,000 ohms in most cases, but to some degree this is a trial-and-error process. Start with the first stage and test as you go. If distortion increases radically, trim the resistor value back a bit. A "Andy Ohmmaker" comes in handy at this stage.

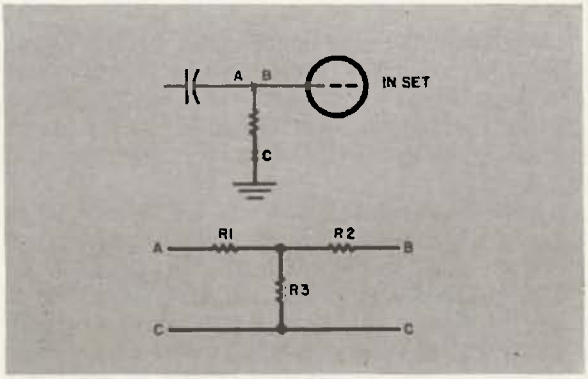
When plate resistor values are changed, the values of grid resistors in subsequent stages must also be changed in the same ratio to maintain maximum gain. However, grid resistors should never exceed 2.2 megohms—and the grid resistor of a power output stage shouldn't go higher than about 47,000 ohms because of grid-emission effects which can seriously damage the tube.

If you're troubled by excess gain, you also have two choices. Either you can install a resistance pad as shown in Fig. 2 to get rid of the excess audio, or you can trim the gain back to size with feedback.

If the only modification you plan to make is in the gain department, the resistance pad is the best bet—mainly because it's simpler. However, if you plan to reduce distortion or to add frequency shaping, wait until those steps are completed before modifying the gain, because your gain requirements are subject to change as the modification proceeds.

Frequency shaping can be attacked in many ways. You can use LC filters, RL filters, RC filters, or combinations of any or all of these. In addition, feedback tricks open whole new vistas of frequency shaping, including adjustable cutoff points.

The classic approach to the situation has been through the use of LC filters. These are



Attenuation Desired	R1 and R2	R3
10 db	270 K ohms	330 K ohms
20 db	420 K ohms	100 K ohms
30 db	470 K ohms	30 K ohms
40 db	470 K ohms	10 K ohms

Fig. 2. Excessive audio gain may be cured by installation of a T-pad as shown. Values given are for replacement of a 470 K grid resistor; for other grid-resistor values, they may be scaled up or down in proportion.

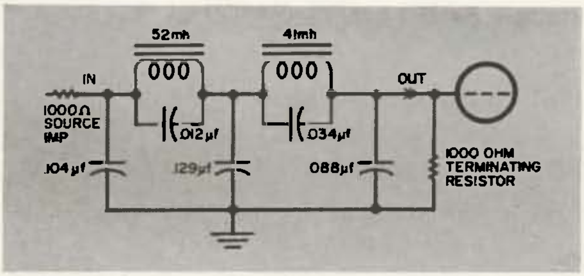


Fig. 3. Low-pass filter for use at 1000-ohm impedance level. Cutoff frequency is 3500 cycles. Passband is flat to 3000 cycles, and all frequencies above 4000 cycles are down 50 db or more. A cathode follower (not shown) is suggested to drive the filter.

available commercially at a cost of approximately $15, and can be homebrewed for about $5 (depending on the contents of the junkbox and your requirements).

Such a filter, designed to pass frequencies below 3 kc without attenuation and to suppress frequencies above 4 kc by 50 db or more, is shown in Fig. 3. Note that the amount of rejection obtainable with this filter is similar to the stability of a VFO—it's determined as much by the mechanical construction of the gadget as by the electrical circuit used.

Input and output of the filter must be completely shielded from each other. In addition, magnetic coupling between elements of the filter must be minimized. Toroidal inductors are recommended for purposes of isolation, but they're usually expensive and hard to locate.

As a matter of fact, unless you like to tinker with the mechanical end of this hobby of ours, you'll probably find it better to either use the commercial filter or to investigate some circuits yet to be described. Construction of a good low-pass audio filter is one of the trickiest things in ham radio.

Turning again to the hi-fi designers, we find that they too have faced a similar problem in the design of the electronic crossover network. There, by skillful use of feedback, they have managed to get LC-filter results with RC components. Since it's the inductive element that plays havoc with homebrew filters, these circuits bear investigation.

One of these circuits is shown in Fig. 4. The low-frequency cutoff is switch-selected, but at the high end you have continuous adjustment of the passband. This enables you to cut it down to 100 cycles or less for CW reception, back out to 300 and 3000 cycles for voice, and even wider if you like to listen to SW music broadcasts from time to time.

Naturally, a project such as this is an outboard unit with its own controls and power supply. About the only way to include such a gadget inside the receiver case is to transistorize it, and that's left up to you, the creative

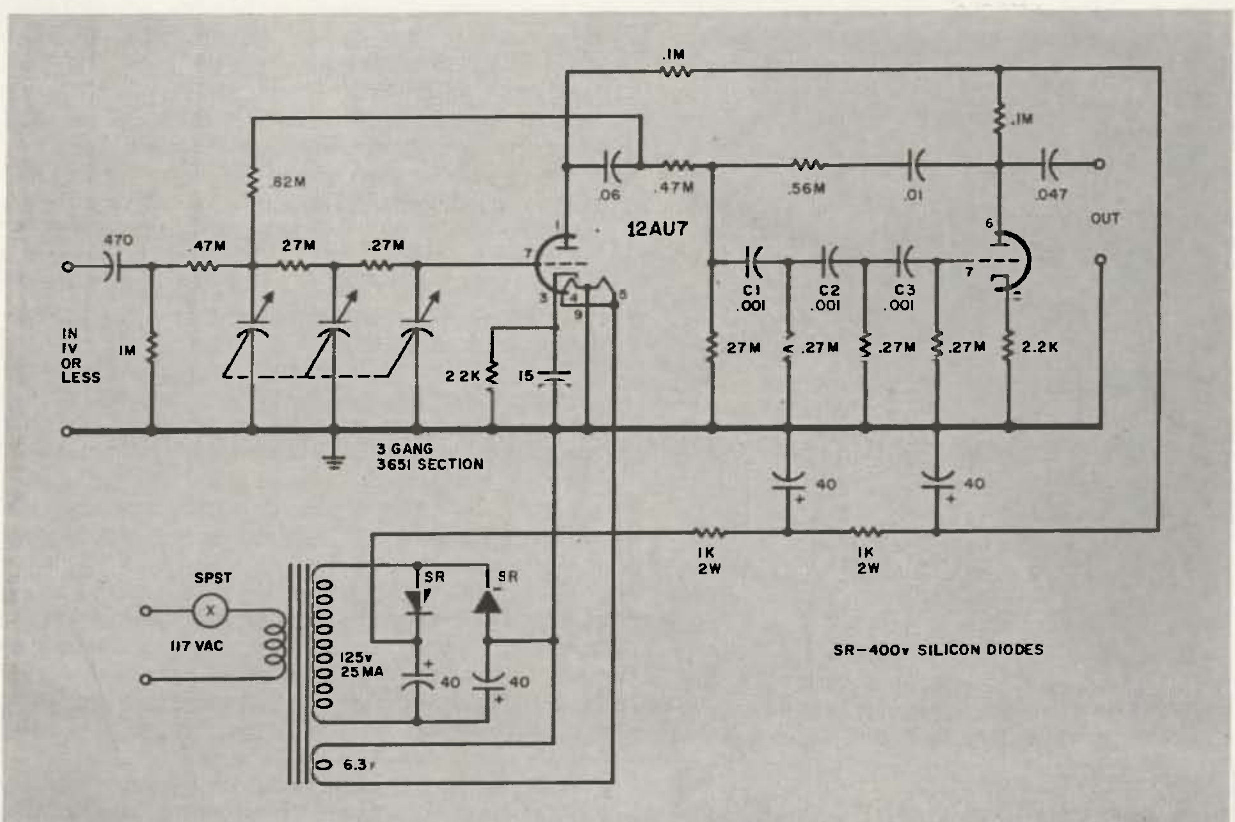


Fig. 4. Variable bandpass filter which provides 40 db rejection of unwanted frequencies. Upper cutoff frequency is continuously variable from 1.8 kc. to 20 kc. Lower cutoff is fixed at 350 cycles. It may be varied by changing values of C1, C2, and C3. Doubling the size of each will lower the cutoff frequency by approximately two times. Over-all gain of the filter is unity.

reader. Design formulae and examples can be found in the references.

Some time back, when discussing distortion, we said that it could be cured permanently for less than a dollar. This is the point at which the details are to be revealed.

Going back for a moment to the hi-fi designers, we find that one of the major advances in the audio art was the introduction of the negative-feedback concept. In case the term is foreign to your experience, here's the idea in capsule form.

Distortion consists of the original signal, plus the distortion component. If the distortion component could be stripped out of the distorted signal, only the undistorted original would remain.

Since any voltage can be counteracted by an equal voltage of opposite polarity, we have a way by which the distortion can be reduced. If the amplifier output is reduced to a point at which it equals the input, reversed in polarity, and then applied back to the input, the only part of the signal that isn't cancelled is the distortion components.

This looks at if it's self-defeating, and in this form it is. But if all input is cancelled, there's no feedback signal. The process adjusts itself so that the composite input to the amplifier will consist of a small input signal and a large distortion component. This distortion is out-of-phase with the distrotion generated in the stage, and so is cancelled out. Since a trace of original input was left, we will have a trace of distortion also—but in practice, this component is reduced far more than is the desired signal.

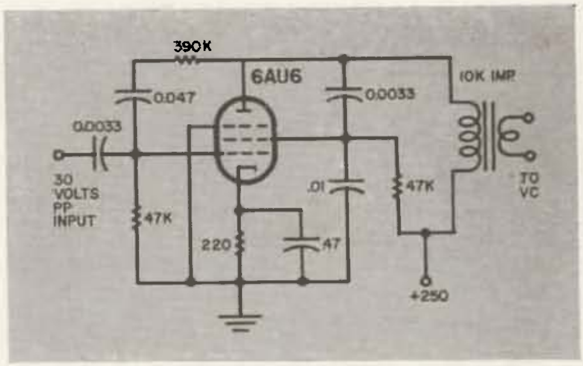


Fig. 6. This output stage will develop 300 milliwatts at approximately 1 percent distortion, and draws only 15 ma at maximum signal. Transformer may be a universal type, or one designed for battery (tube-type) portable use. Note use of feedback to reduce distortion. If feedback resistor is omitted, drive requirement is only 3 volts peak-to-peak but distortion rises to nearly 10 percent.

The disadvantages of negative feedback as applied to communications receiver audio are threefold: If too much feedback is applied the amplifier may break into oscillation in spite of the reversed polarity; the driving voltage requirements go up in direct ratio to the amount of feedback used; and feedback extends the bandwidth of the stage.

That last item is usually considered an advantage, and is an additional reason for use of feedback in hi-fi work. However, it would play the dickens with our carefully-worked-out 300- and 3000 cycle cutoff points were they included within the loop. This pitfall is avoided by adding the feedback loop in such a manner that all frequency shaping is done before feedback is applied to the signal.

The other two disadvantages are taken care of by proper design. Instability is avoided by using only enough feedback to clean up the signal to the point of acceptability. Increased drive requirements are handled in the same manner as "insufficient gain"—by adding an outboard stage or by changing component values in earlier stages.

The only tricky thing about the addition of feedback is to make certain that the phase is correct. Remember that the phase of the audio signal undergoes a 180-degree change in each stage. Thus, taking the signal from the output-tube plate and returning it to the grid of the same tube would be correct, but returning it to the grid of the driving tube would be disastrous. To include the driving tube in the loop, the feedback must go to its cathode (which then cannot be bypassed). Typical feedback loop installations are shown in A and B, Fig. 5. Additional information on feed-

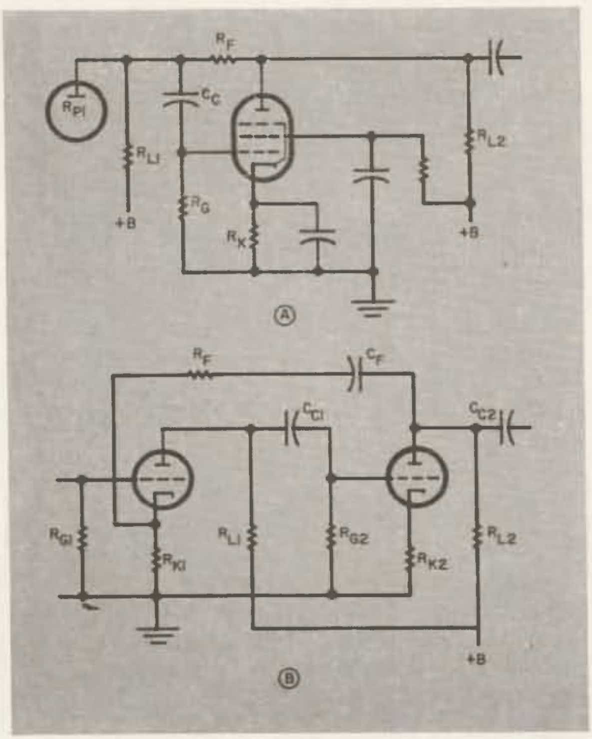


Fig. 5. Typical feedback loops. Shown at A is single-stage loop; at B is two-stage feedback. Feedback voltage is determined by ratio of Rf to the parallel combination of Rpl, R11, and Rg in A, and of Rf to Rkl in B. Cf blocks plate voltage but must be large enough to be a virtual short to the audio at all frequencies.

Improve Meter Accuracy

Recently I acquired on the surplus market a 3 inch 0-20 ma meter. Unfortunately the internal resistance was not known. The standard method of finding internal resistance, as in the handbook, gave 1.6 ohms. Considering the inaccuracies that were present, that figure was probably within 10% at best. When a meter is used as is, the internal resistance is not too important. For shunting, however, the internal resistance must be known accurately. To improve meter accuracy, I added an 8.4 ohm 1% (?) homemade resistor in series to bring the "internal" resistance to 10 ohms. This resistor was wound from a carefully measured length of copper wire. Since the major inaccuracy is now 10% of 1.6 ohms, or .16 ohms, the total variation is now .16/10, or about 2%. This technique will work on any meter with a low full-scale voltage drop.

. . . KøWML

(. . . Lo Fi from page 48)

back in general can be found in the bibliography. Just be careful that neither the volume control nor any frequency-shaping components are included in the loop, and you'll have no trouble.

This brings us to the subject of power for the audio section, the last requirement for acceptability. A low-but-adequate-power audio output stage is shown in Fig. 6.

The circuit, adapted from a Korean-war-vintage design for a portable BC set, proves especially useful for fixed-station work. It is capable of about 300 milliwatts output, and with an efficient speaker system will prove to you that there's no need to burn up some 35 watts with a pair of 6V6s in the receiver. It can easily be added to almost any set.

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LETTERS

Greetings OM:

Problems! March 73 page 12 schematic leaves the 9 volt battery always in circuit. Then, in my own article, on page 18, we forgot to mention removing the jumper and attaching the coax after grid-dipping. Then, me again, on page 43 it is not clear that the resistor goes to point X, the volume control to point Y and ground to Z.

Al Newland W2IHW

Ahem! Well, on page 12, though our schematic agrees with that sent in by the author, I would suggest moving that ground over to the other side of the S1A switch. Thanks for the elucidation on the other two items.

To The Editor:

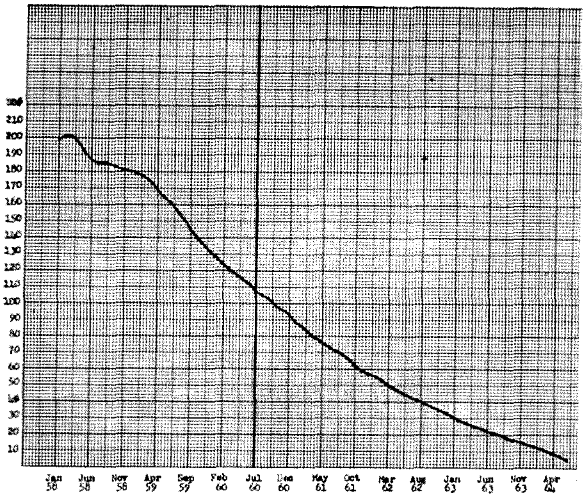
On page 50 of the March 1961 issue of 73 the article titled "Chassis Mounting the PL-259" states: "The second item that cannot be obtained commercially is a double ended male plug." These double male plugs are manufactured by the Dow Key Company and are in-stock items in most amateur radio supply houses in this area.

Vincent Colling WA2EKP
NRM Wholesale Radio, Inc.

Dear OM:

Running 70 watts on six meters (Viking Challenger) I naturally (?) ran into TVI. Filters, etc., etc., were tried with no significant success. To condense the drama, here is how I completely eliminated my TVI. I took my own TV antenna down and cleaned it carefully with Brillo, replaced the twinlead and the screws attaching the feeder to the antenna. Presto: no more TVI. Even with the rig poorly tuned there is no problem. I suspect that the oxide on the antenna terminals rectified and reradiated my six meter signals into the neighbor's TV sets. Now everybody is happy.

Gibbons Jeansonne K5000



(. . . Propagation from page 21)

Sunspot Cycle quite well, and also what variations are completely absorbed by the smoothed cycle in Fig. 1. This curve is only four months behind the mean monthly cycle data. The curve in Fig. 4, while still being very rough, is only two months behind the mean monthly cycle of Fig. 1 and from these curves the tendency of the smoothed cycle can be kept up to date.

The time of minimum for the present cycle can not be determined exactly, very far in advance, however, Fig. 5 is my prediction of smoothed numbers for the rest of the cycle which I think will have its minimum around June 1964. A more accurate determination of minimum for a short cycle can be made when the smoothed numbers reach 1/9th of the maximum value (about 22) because minimum tends to come about one year later; also when the 1/11th value is reached (about 18) minimum tends to come ⅔ of a year later.

Part II will cover the variations in MUF, diurnal, seasonal, and with sunspot cycle.

. . . K2IGY

Ham Headlines

If ham radio makes the newspapers in your town please send a clipping to Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Marvin runs the 73 News Service, a monthly publication sent to all editors of club bulletins. He will digest the most important stories that are submitted each month for us to print in 73.

HAMS AID IN TORNADO

(Chicago Sun-Times, Chicago, Ill.) Scores of hams answered a South Side Chicago ham's plea for help after a tornado struck the area. For hours during the night they directed traffic, provided transportation and generally assisted the police department.

AMATEUR SUED FOR LENDING AID

(Chicago Sun-Times, Chicago, Ill.) Maurice R. Franks, Jr., a university student and avid ham operator who played an important role in a recent Chicago tornado found himself subject of a Superior Court Suit. A landlady filed the suit claiming that Franks' transmitter interfered with 100 television sets in her apartment building as he aided in storm communications. She is asking that he be enjoined from operating his station and also requests a permanent injunction.

RADIO OP FAILS TO SAVE WOMAN'S LIFE

(Daily News, Brooklyn, N. Y.) Angel Fernandez, a Brooklyn ham radio operator, made a desperate attempt to save the life of a critically ill woman, Mrs. R. Cocido, in Buenos Aires, Argentina. She was in grave need of a new antibiotic made in U.S. Fernandez received a radio message about the woman's plight and after spending $160 of his own and arranging for speedy delivery of the medicine via National and Panagra Airlines, he learned that his efforts were in vain. The drug arrived seven hours after Mrs. Cocido died.

AMATEUR OPERATORS STAND-BY

(Cleveland Plain Dealer, Cleveland, Ohio. Submitted by Tom Hill, K8DHX) Twenty five amateur radio operators were at their sets in different parts of the county to provide emergency communications after a severe storm struck Greater Cleveland recently.

ACKNOWLEDGMENTS

We would like to acknowledge two ham stories that appeared in the Syracuse Herald-Journal and Buffalo Evening News, respectively. The former was written by K. W. Thomas, a ham of 18 years standing, who substituted a bit about ham radio for a regular columnist. The latter concerned C.D. operations of a youth, 17 year old Peter Lascell, of Chautauqua County, N. Y.

AF MARS TECHNICAL NET

Sundays 2-4 pm EST **3295-7540-15715 kc**

May 7—Telemetry; Modern concepts and applications.

May 14—Semiconductors.

May 21, 28, June 4, 11—Review of basic physics.

Information Field Day—A full day of hamming in North Hollywood Park with public displays proving that "Radio ham" is not synonymous with "TVI." Members of San Fernando Valley Radio Club presiding.

Jim Morrissett WA6EXU

TODAY I watched the unusual meeting of hams (cool under the collar) discussing TVI with civilian-televiewers (strangely not about to blow their lids, either). In fact, calm discussion was startlingly prevalent. The only demonstrations were non-people type, peaceful and effective. Potentially irate citizens watched with interest, as side by side, sets with and without TVI functioned in the midst of a howling nest of field day transmitters on all amateur bands.

Public Information Field Day. New name for a new event that pays off in good will.

On a pleasant Sunday afternoon in Southern California, the San Fernando Valley Radio Club held its first annual PIFD. The location, no far mountain top or obscure ham haven, but a grassy park in the middle of North Hollywood. The purpose, besides an excuse for an outing, to promote better understanding between the public and the radio amateur. The FCC is co-operating fully and wishes that clubs all over the country would do the same to help them get TV-gripers out of their hair.

Between 9 and 4 on Sunday, Feb. 26, hundreds of people sauntered in, stood around getting informed, and sauntered out again. When they sauntered out they carried with them a healthier attitude toward amateur radio. A few were keen to know more about this hobby, once they realized one could be a TV-watcher *and* a ham, even simultaneously if you care for that sort of thing.

The PIFD demonstration turned out to be such a good idea it was repeated by request at the Sportsman's Show at the Los Angeles Coliseum March 15-27, where K6BSA operated four transmitters simultaneously, the SFVRC furnishing the same before-and-after TVI and de-TVI display.

Troubled with the neighbors? If they're miffed, invite them to PIFD. . . . **WA6EXU**

Letters

Dear Wayne,

Here is a rig you will be seeing a lot of before long. This is one of the hottest items I've come across yet. Let's see what you think of it.

The kit of parts sells for $50, a bargain, cannot be bought across parts counter for this price. The board, a nifty job with all drilling done and brass eyelets inserted at all connection points, $15. This is the extent of the stuff Denney furnishes, besides instructions.

Other parts needed:

Collins Mechanical Filter (about $43).

Carrier crystal (or 2 crystals if upper and lower sideband desired), ground to exact frequency to match Collins filter.

Tubes run about $17.

Outboard VFO operating at output frequency plus 455 kc. The rigs are normally on 40, can be converted without too much trouble for 80 and 20.

External power: 300 v @ 100 ma. Filaments 6 or 12 volts.

External speaker 3-4 ohms.

External rf gain control (dc only on cable), 50K.

Mounts on 7 x 13 x 2 chassis.

2 good watts measured output, enough to drive a kw.

Receiver sensitivity 1 mv. Reports on the receiver section are that it is very hot.

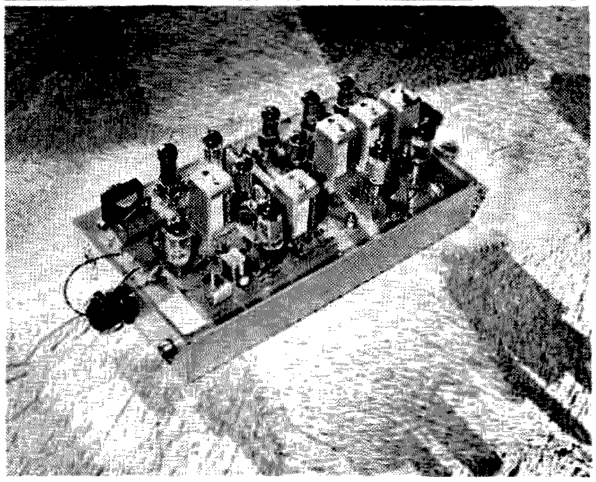
T-R is accomplished by switching of B-plus line. Circuitry is such that no other connections need be switched for transmit-receive. Designed primarily for mobile use where VOX is not desired.

Looks like this will fill a real need. A good, reliable sideband transceiver with which the ham who knows virtually nothing about sideband can make the leap to sideband, with a complete station costing less than a comparable AM rig!

(Continued with pix on page 58)

(. . . Letter from page 57)

The circuitry was first developed in the fabulous Jennings shack by Don Johnson W6AAQ, father and midwife to some of the most fascinating SB rigs to appear on the scene in recent years.



Denney Moore, W6MHP, has taken over production of the printed-circuit boards and furnishing of the kits of parts and instructions. W6MHP plus Mrs. Moore constitute the D. Moore Company, which has earlier put out the Reflect-O-Match, a gem among SWR devices.

Orders are now being filled by D. Moore Company, 1236 Virginia Ave., Redwood City, Calif.

. . . Jim Morrissett WA6EXU

Well Jim, you're just a bit ahead of me. I got a good look at it in the Jennings exhibit at the IRE show in March and am just as enthusiastic as you about it. Paul Barton, W6JAT went over all the details for me. From what I can see, Mrs. Moore should soon be up to her elbows in printed circuit board drillings. Hope you gave them one of our rate cards bwah! . . . Wayne.

Gentlemen:

Would you please announce the Burlington Amateur Radio Club International Field Day Hamfest at Burlington Vermont on June 17-18 . . . the largest hamfest north of Swampscott. Registration is $3 thru W1OJO, Box 684, Burlington, or $3.50 at the gate, and includes a two hour ferry ride across Lake Champlain.

K1CEG Bert Perry

Other Ham Publications

In lieu of half of the magazine being filled with specialized departments, we recommend that you subscribe to the bulletin of your special interest. You get a lot more news and get it faster this way . . . and you encourage the fellows who are putting out these bulletins.

73 HAM CLUB BULLETIN. Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Sent free to all editors of ham club bulletins monthly to keep them abreast of what is going on with all the other ham clubs. This is an excellent source of news for putting together your club bulletins. To subscribe to this news bulletin just send a copy of your own club bulletin to Marvin.

SIDEBANDER. Official organ of the Single Sideband Amateur Radio Association, 12 Elm Street, Lynbrook, L. I., N. Y. Subs include membership to SSBARA: $3 per year. Monthly. Primarily operating news and chit-chat for the SSB DX gang.

THE OLD TIMER'S BULLETIN. Published by Bruce Kelly W2ICE, Main Street, Holcomb, New York, four times a year. $1 per year. Pictures and discussions of old ham gear, old ham ops and old ham doings.

VHF AMATEUR. Published monthly by Bob Brown K2ZSQ(T), 67 Russell Avenue, Rahway, New Jersey. $2 per year. Operating news for VHF'ers.

DX-QSL News Letter. Clif Evans, K6BX, Box 385, Bonita, California. Published quarterly. 40¢ each; Annual subscription $1.25 (four copies) by first class mail ($1.50 for DX stations). Lists all QSL Bureaus, managers for rare DX stations, etc. Why not send your old Callbook to a DX ham? Write Clif for the name of someone who needs it.

DIRECTORY OF CERTIFICATES AND AWARDS. Clif Evans, K6BX, Box 385, Bonita, Cal. Complete Directory plus one year of revisions (quarterly) $3.50. Add 75¢ for 1st class mail; $1.25 for airmail; DX stations 1st class mail add $1.00. Needless to say, this is the most complete collection of data on the hundreds of certificates and awards available.

FLORIDA RTTY BULLETIN. Fred W. DeMotte W4RWM, P.O. Box 6047, Daytona Beach, Florida. $3 per year including membership in Florida RTTY Society. Mostly operating news with a bit of technical info now and then. All TT men should be getting this.

SOUTHERN CALIFORNIA RTTY BULLETIN. Merrill L. Swan W6AEE, 372 West Warren Way, Arcadia, California. $2.75 per year, not including membership in Society. Operating news and some technical articles. This is the oldest TT Bulletin going. All TT men should also get this one. Monthly.

Old Call Books

Few DX operators can afford to buy a Callbook. If you have one that is less than three years old that you would like to send to a DX ham then drop a card to Cliff Evans K6BX and he will send you a letter from a DX ham that would like to have your Callbook. K6BX, Box 385, Bonita, California. We think this is a wonderful service and extend our best regards to Cliff for his work.

Radio Bookshop

On the off chance that someone may read this ad who has the bug to read a little on their favorite subject, we've laid in a stock of the following books.

2 — ELECTRICAL ENGINEERS' HANDBOOK — Pender-McIlwain. This huge book should keep you busy for months just reading the interesting facts it contains. There is hardly any problem in communication or electronics that you can't find covered here. Excruciatingly thorough. 1618 pages. **$10.00**

6—VACUUM-TUBE CIRCUITS AND TRANSISTORS—Arguimbau. Designed for both beginners and engineers. Math kept to a minimum. Simple explanations of complex ideas. You'll know a lot more about radio after you read this book. 646 pages. **$10.25**

8—RADIO-TELEVISION & BASIC ELECTRONICS—Oldfield. Logical presentation and descriptive illustration make this an ideal book for the beginner. Written by self-learning of electronics principles. 342 pages. **$4.95**

13—REFERENCE DATA FOR RADIO ENGINEERS. Tables, formulas, graphs. You will find this reference book on the desk of almost every electronic engineer in the country. Published by International Telephone and Telegraph. **$6.00**

20—RTTY HANDBOOK—Kretzman (W2JTP). A-Z of ham Teletype. Very popular book, low supply. **$3.00**

32—RCA RADIOTRON DESIGNERS HANDBOOK—1500 pages of design notes on every possible type of circuit. Fabulous. Every design engineer needs this one. **$7.50**

33—WAVE PROPAGATION & ANTENNAS—Welch. Highly recommended by the propagation experts as the best Book on the subject. **$5.75**

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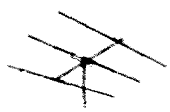

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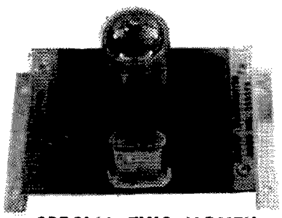

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Advertisers Index

Alden . . . 52
Allied Radio . . . 64
Alltronics-Howard . . . 53
Arrow Electronics, Inc. . . . 7
Barry . . . 50
Candee . . . 56
Central Electronics . . . 8
Clark . . . 51
Clegg . . . 1
Colorado Ham Directory . . . 50
Columbia . . . 54
Cushcraft . . . 61
Editors & Engineers . . . 59
EICO . . . 5
Evans Radio . . . 49
E-Z Way Towers . . . 6
Finney . . . 21
Globe Industries . . . 52
Gonset . . . Cover II
Graham . . . 62
Heath . . . 13
Hi-Par . . . 57
House of Antennas . . . 62
International Crystal . . . 2, 11
JSH . . . 58
KTV Towers . . . 60
Lafayette Radio . . . 19
Lektron . . . 60
L-W Electronics . . . 53
Mach . . . 60
Maps . . . 52
Mercury . . . 62
Multi-Products . . . 51
National Radio . . . Cover IV
Neil . . . 49
Petersen . . . Cover III
P & H . . . 58
Radio Bookshop . . . 60
Reyco . . . 51
Seg Electronics . . . 54
Shorecrest . . . 55
Subscriptions . . . 6
TAB . . . 63
Tapetone . . . 57
Technical Material Corp. . . . 17
Telrex . . . 51
Texas Crystals . . . 55
US #1 Electronics . . . 61
Vanguard Electronic Lab . . . 61
VHF-UHF Associates . . . 62
Western Radio (Nebraska) . . . 59
Western Radio (San Diego) . . . 53

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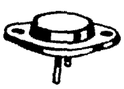

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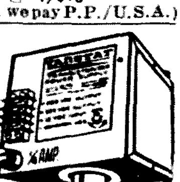

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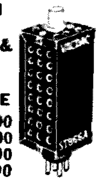

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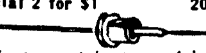

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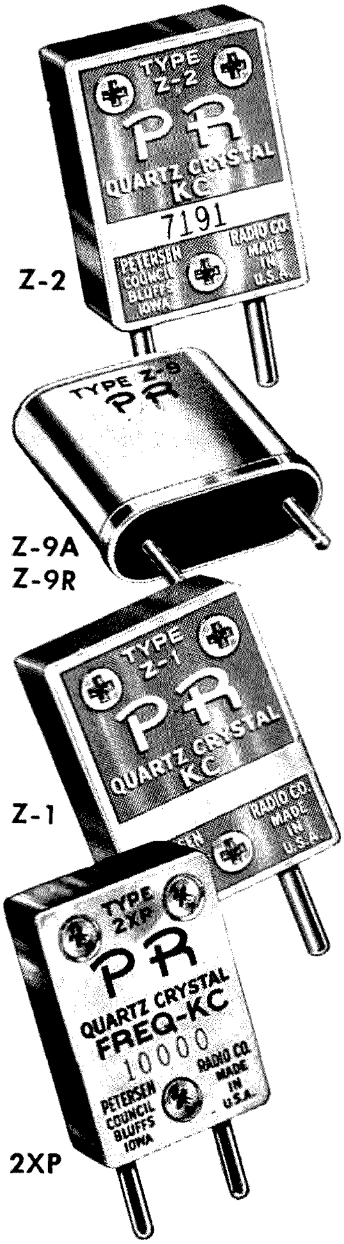

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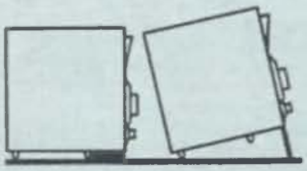

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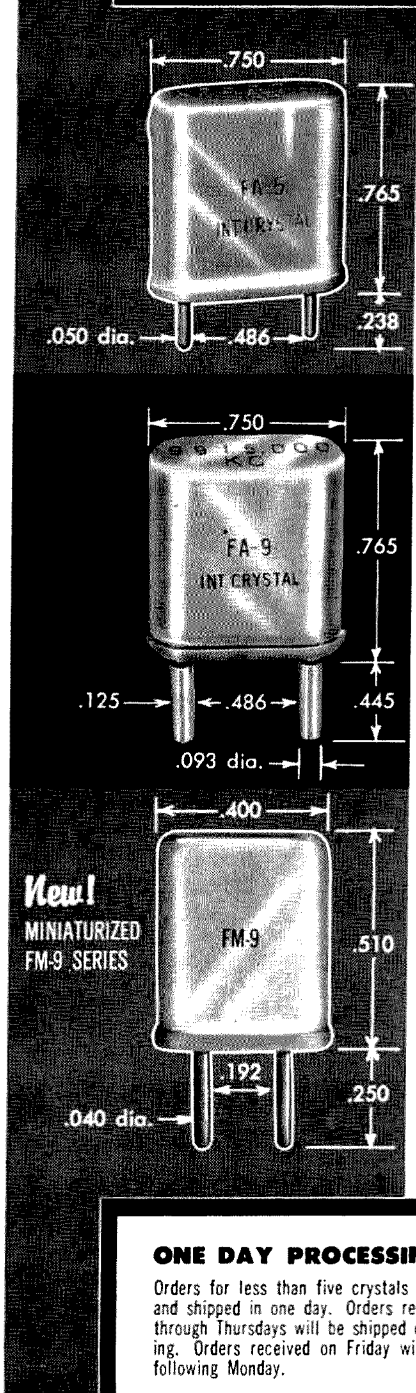

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	10000 - 14999 kc	$ 4.40	10000 - 15000 kc	$ 5.50
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Overtone (3rd)	10 - 14.99 mc	$ 4.40	Not available	
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73 Magazine
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June 1961
Vol. 1, No. 9

Table of Contents

Abe Lincoln .... Bill Ashby K2TKN 8
Two meter antenna for mobile or fixed. Looks awful, works great!
75M Transistorized Converter .... Harold Johnson WA6DZL 12
Nice little one evening construction project.
Precision Capacity Measuring .... John Reinartz K6BJ 14
Right down to a fraction of a mmfd.
Propagation, Part II .... Dave Brown K2IGY 16
When the sun spot null will really come and what it will be like.
73 Tests the M-100 Modulator .... Charles Spitz W4API 20
Just how good is that gate modulator put out by Electrotone?
AM Modulation Monitor .... James Tonne W5SUC 24
A bit complicated, but great for perfectionists.
Modifying the KT-200 Receiver .... Bill Orr W6SAI 30
Bill claims this is a real good deal with these few changes.
Pandapting Adaptor, Part I .... John Ellison W6AOI 33
Moderately simple device connects your receiver to your 'scope.
Automatic Drive Control .... Vernon Trexler W5IUR 38
Transistor device keeps you from overmodulation. Clever.
Dear Sir .... Allie Peed K2DHA 39
On writing to manufacturers about your miseries.
FCC Notice .... Wells Chapin W8ONL 41
Thought you'd get a kick out of this bit of antiquity.
Do-It-Yourself IBM .... Jim Kyle K5JKX/6 44
Punch a few holes and get some real mileage out of a card file.
Power House Pros .... Staff 51
Part I, all about power supplies.
Propagation Chart .... Dave Brown K2IGY 54
DX men please note that this is the most accurate forecast in print.
The DX Hunter .... Ken Johnson W6NKE 56
Do's and don'ts of DX hunting.

Misc.:

Table of Contents 3
de W2NSD (editorial) 4
Subscription Rates 6
Whipping Things Up 13
Don't Break Those Good Taps 29
Meter Insulation 32
Field Day Power Source 42
AF MARS Technical Net 43
Subscription Form .... post card

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. . . de W2NSD

(never say die)

The cards from the May issue have been coming in quite satisfactorily. They've kept me up to all hours hacking the information requests out for advertisers and toting up the article votes. The addition of the "Message to the editor" to the card this time resulted in a slightly puffed ego from all of the kind words. Some few suggested things they'd like to see in print. It struck me that this might act as a spur to fellows who may have just what these chaps want, but haven't written it up yet. So how about making a note of something you'd particularly like to see in print on the card this month . . . and don't forget to fill in some of the information request blanks.

Some of the items requested this month that stick in my mind are: anything on RTTY, more SSB articles, more VHF construction projects, a converter for the aircraft frequencies from 108-138 mc, how to take good equipment photographs, surplus conversions, etc. One chap wanted a 25 watt 160 meter CW rig to carry him through the next few years of the sunspot cycle. Almost anything transistorized is read avidly, and Nuvistors are still Nu.

April Votes

The card in the April issue just about snowed me under trying to count all the votes. They're still coming in every day, but we have to stop somewhere, and besides, there no longer is any question about which article wins for the month. Here are the votes:

Nuvistor Converter K8BYN	1609
Noise Limiter K5JKX/6	1352
Take Your Pick, Staff	972
Tennessee Indians K2SJN	698
Transistor Modulator KL7DLC	655
Heathkit Twoer W3UZN	489
Modulate Not Crepitate K4ZGM	428
Calibration W4WQT	426
Have Wave Feeders W9HOV	377
Power Meter K8ERV	358
RF Noise Suppression K2TKN	355
Boosting Command Audio K8HDR	307
Big Cannon W6VVZ	297
Write for 73, Staff	272
Automation K5JKX/6	180

When the 14th most popular article in an issue gets 180 votes, I'd say that we're doing pretty well!

Implicit-Explicit

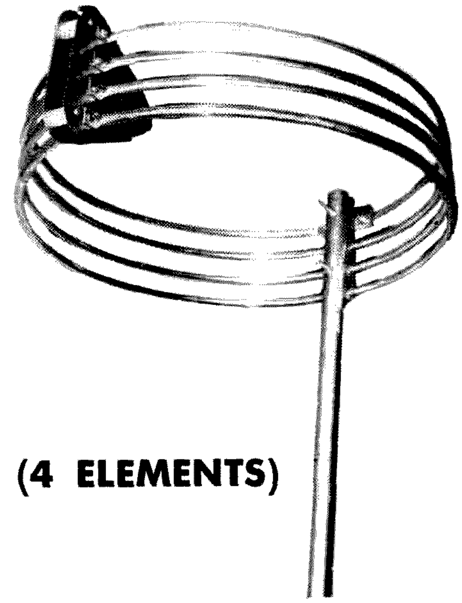
While on my way up to Rochester to give a talk at the Hamfest (and sell a few subscriptions), I got to mulling over the problem of getting fellows to build equipment and the 73 approach to doing something about it. The more I mulled the more I was aware that my good old New England taciturnity had won out again and that I had said in much too few words what I had intended to communicate way back in the first issue. Bear with me while I elaborate a bit on the general theme.

After leaving my former place of employment I spent a couple weeks kicking myself for not having left a year or two earlier and then decided that the best course of action was to take the bulls horns and put out my own ham magazine. I had been grumbling in my editorials for several years about the decline in home construction, but hadn't figured anything to do about it. Now, with some time for investigation, I started taking a long look at the problem and came up with a theory that seems to be proving correct. A careful inspection of the ham magazines made it obvious to me that *they* were largely responsible for the drop in construction.

A quick riffle through the back issues of ham literature will bring this point home, I believe. I found that there were only a handful of simple construction projects being published each year, and most of these were items for Novices and were of little interest to the bulk of the hams. I noticed that much of the gear being described had obviously been built in a well-equipped lab and had been tuned with lab test equipment that just isn't found in many ham shacks. The very perfection of the gear being described is a psychological stumbling block for the chap who would like to duplicate it.

Looking further in the ham magazines I found that the bulk of them were filled with operating news. It is axiomatic that everyone likes to see his call in print, but when it gets to where this is the major part of our literature then something is wrong. In addition to large segments of the magazines being admittedly devoted to catering to this form of flattery, there are even greater bundles of pages doing the same thing under an assumed name. I had tried, unsuccessfully, to change this course of events in years past, and decided that now was the time to correct this problem. You see, I envisioned special interest columns as devoting their space to a discussion of technical topics, not to an extension of the operating news section of the magazine.

(Turn to page 6)



A VHF column could well devote itself to technical topics and continue to be interesting indefinitely without ever mentioning who was working whom and with what rig and antenna. The RTTY column could well continue forever and never exhaust the technical side of this facet of the hobby. Even a DX column could stick to technical topics, with discussions of antennas, low noise pre-amps, antenna switching, feedlines, possible DXpedition sites, etc.

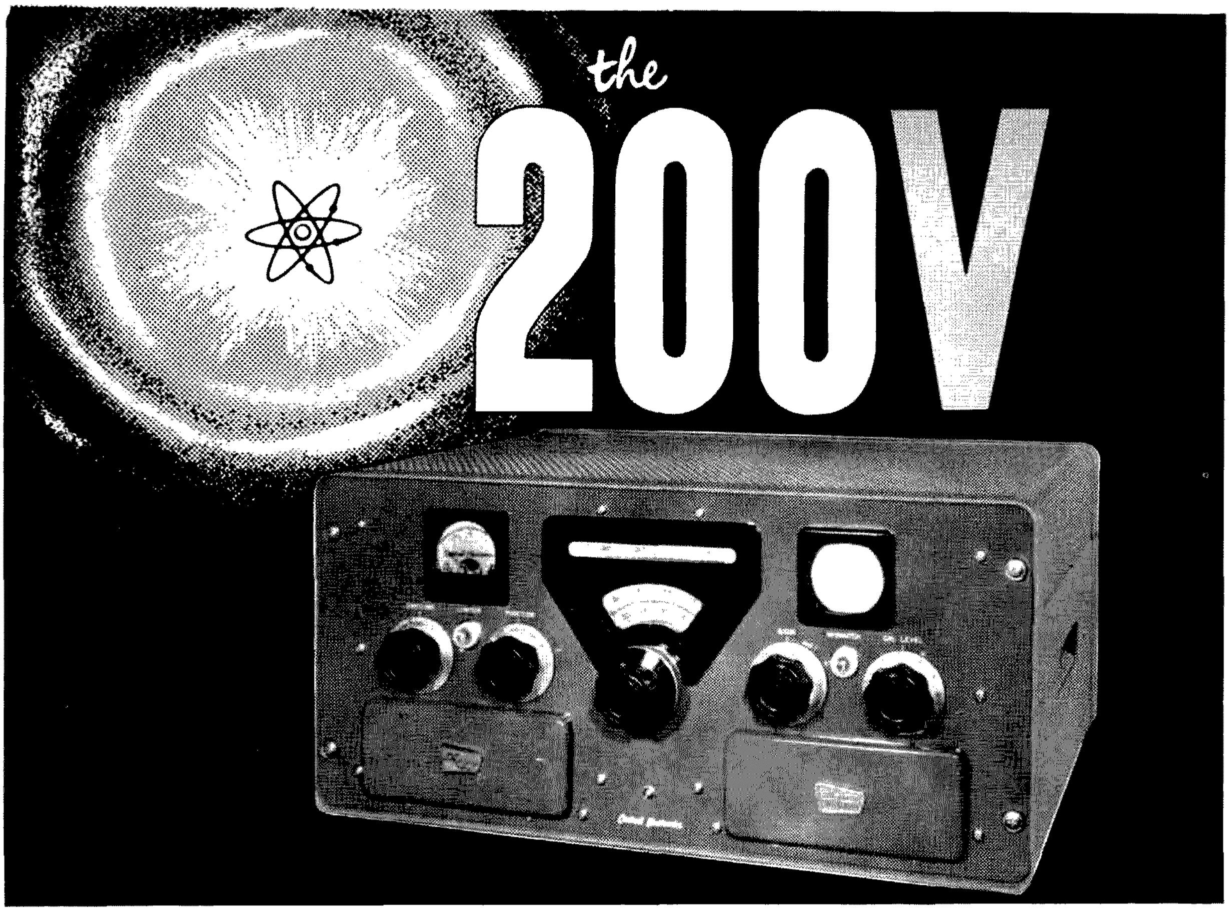
The difficulty with running columns of this nature is that an editor would have to find fellows who are willing to work full time writing them, for they would take many times the effort to prepare that the present columns do. But then, why have columns at all? If something is interesting enough to be printed in a column it can just as well be run as a feature article. And that is what we are doing with 73. The pages of 73 are open to anyone that would like to run a monthly column . . . all you have to do is have enough interesting information and keep sending it in.

Something New

One thing that has bugged me for a long time are the articles that I occasionally have to reject because they are of too limited interest. These may be well worked out conversions of surplus items, modifications of commercial gear, etc. Usually these are long articles and would be of interest to only a small fraction of the readers. I have a solution that should be fine for both author and reader. On these long articles we would publish a short article in 73 describing the equipment or modification and then make the detailed instructions available for $1.00, half of which would go to the author. The other half would go toward defraying our costs of publishing the article, mailing it and keeping records on the whole operation. This is obviously a looser for us, but it will serve a purpose. And who knows, once we get it started and find out that it is a good idea; we might raise the price just enough to make it break even. If you have any manuscripts that might fit into this category you might consider our proposition.

Subscription Rates

While we do not consider a subscription blank an absolute necessity for starting or renewing your subscription, it may simplify matters for you. We have bound one in his issue so it is not necessary to rip your copy of 73 all to shreds. Rates: $3 per year; $5 two years; DX operators $4 per year. Back issues: 50¢ each. Subscriptions start from current issue only.



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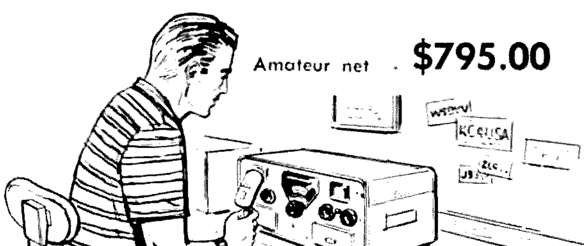

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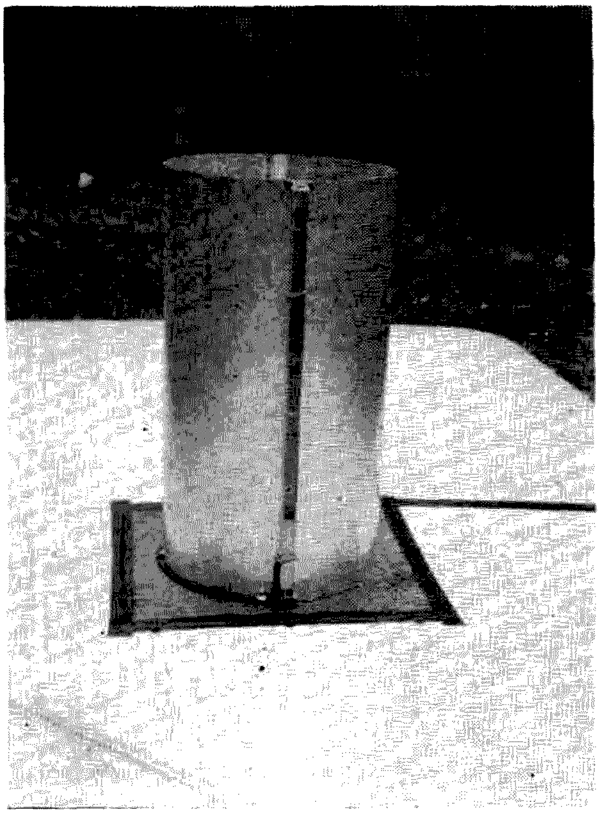


The "Abe Lincoln"

Bill Ashby K2TKN
Box 97
Pluckemin, N. J.

THE second most popular point of discussion, when a group of hams meet, is what form of antenna works best in a restricted space. When a mobile, horizontally polarized solution is required, the theories are many, workable practical answers few. Many years ago the writer, then WØETJ, shook up a few highway travelers by driving all over Missouri, Illinois, Indiana, and Ohio with a pair of 5 element two meter beams, stacked and on a rotor, all mounted on the back bumper of the car. From the ridiculous to the sublime, many wild combinations were used, all good in theory, most poor in actual radiated signal or mechanical monstrosities.

In 1949, I decided the Halo was the best mobile, horizontally polarized compromise—but it had to be designed properly. Most so-called Halo's in use today are actually Ram's Horn antennas. A true Halo is a shortened 8JK flat-top beam, so arranged mechanically that it has end-fire gain in all horizontal directions. Current must be fairly equal in all parts of the radiating portions and 180° out of phase at any two points opposite each other across the circle. Very little energy is radiated up or down; this is why a good Halo works out well in mobile installations, with almost 3db gain over a dipole's best direction.

Few people understand the simple principles of why a Halo works, as evidenced by many commercial versions copied from bad information they have gleaned from VHF articles and columns of other amateur publications. Taking a dipole, folded or otherwise, and bending it into a circle, does not make a Halo antenna. The result is non-directional, in fact it doesn't radiate well in any direction except up when installed near a large chunk of metal. A good 2 meter Halo is small, not over 10 inches in diameter, better if only 8". To resonate to frequency, of course, capacitor loading of the open ends is required, a lot of capacity! Thus, current is almost uniform at any point around the circle, end fire directivity across the circle becomes very evident, and radiation angle is low, very little up or down, most out where it does the most good. Radiation is practically uniform thru the full 360 degrees.

Enough theory—how about practice—spin your existing antenna around on its mounting while listening to a weak signal; if there is any variation in signal strength as the antenna is rotated about its mount, you do not have a good Halo, "picket-fence" phase-shift on reception has been evident, and physical mounting position will be critical; it is working as a Rams Horn.

Since Halo's are not easy to get operating properly in actual practice, further investigation seemed to me to be in order. An antenna type used in commercial FM Broadcasting for many years looked promising—it is the Slotted-Pylon. This antenna is a vertical pipe, 1/10 wave length in diameter, approximately ¾ wave length high, with uniform horizontal coverage. Of much interest is the fact that both top and bottom of the cylinder are points of zero rf.

A full Pylon-Slot was constructed, mounted on the rear bumper of the car, and then the fun began. On two meters the sizes work out

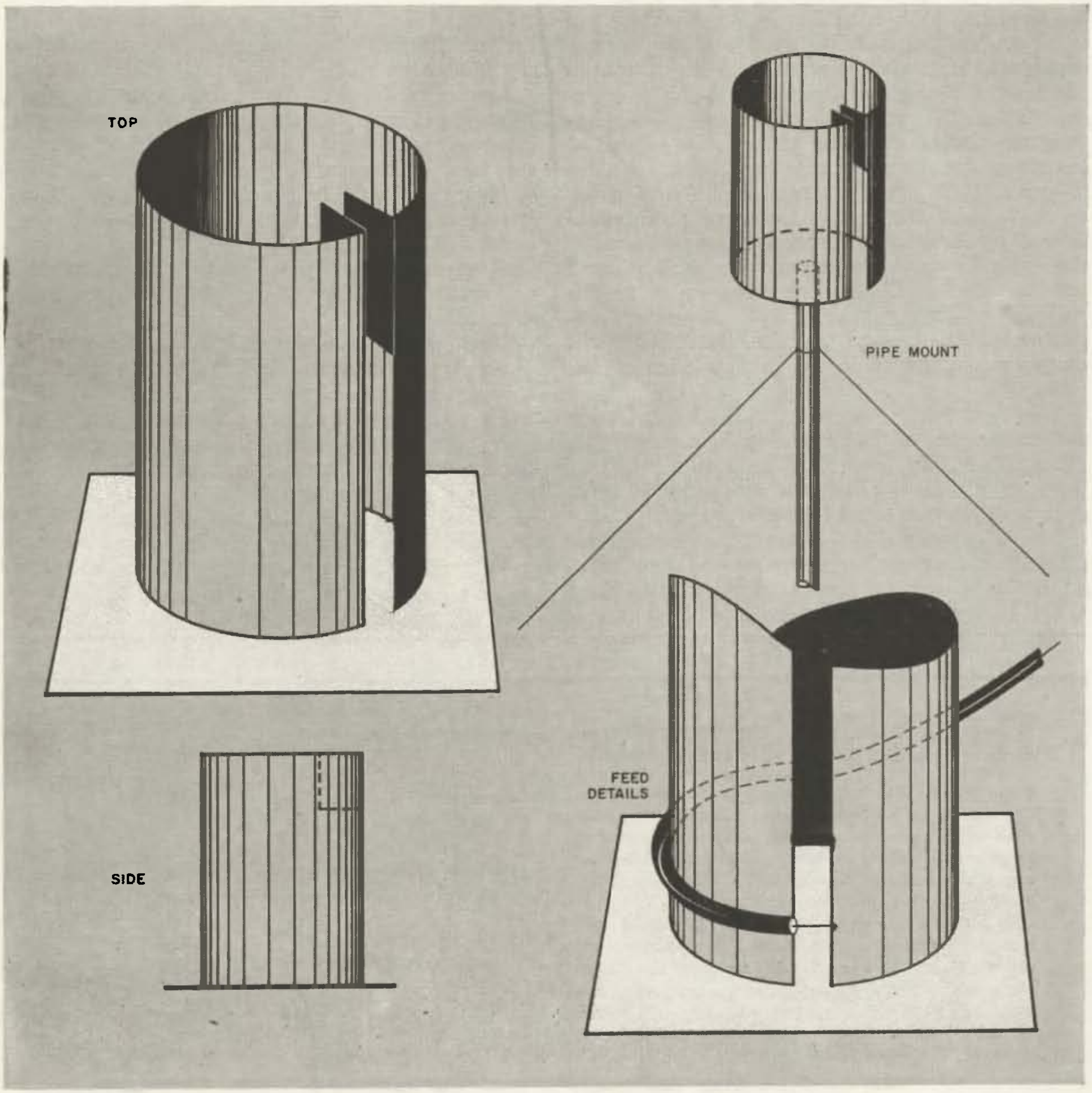
as follows—10 inches in diameter, 60 inches high, with a 1 inch slot running vertically from top to bottom. The ends of the slot are shorted (the circle is complete), the top and bottom of the main cylinder can be left open or covered with metal with no difference noted in performance.

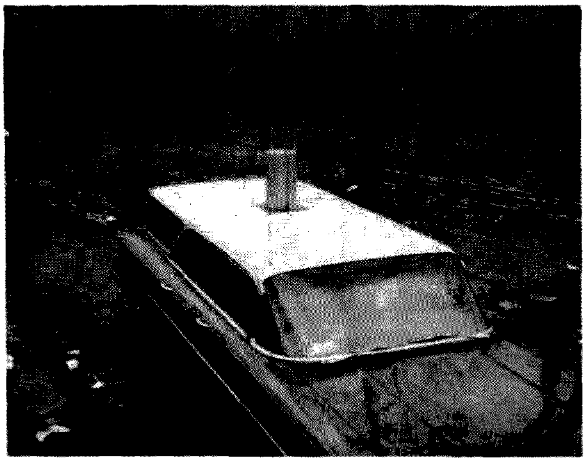
This antenna was the center of attraction at the Syracuse VHF Roundup in 1959. It was a stand-out in a parking lot famous for real "out" mobile VHF installations. Many XYL's left thanking heaven that their OM had only installed a sensible Halo (?) on their family heap. This antenna really pokes out a signal, approx 6db over a dipole, but a state cop can spot you a mile away—Tony, VE3DIR, almost ran his station wagon off the road when he saw me come over a hill, stove-pipe waving in the breeze!

After cleaning out all country telephone lines in the area, and leaving a few dents in low bridges, I decided to see if the monster couldn't be reduced in size a bit, without losing too much signal. The "Abe Lincoln" is the result.

This is shortened bottom half of a Pylon-Slot. It is mounted flush in the middle of the roof of the car, secured with wide masking tape, which is renewed occasionally. It can be fabricated out of any conducting material. A word of warning—certain sized holes create a siren-effect at various speeds—the unit pictured has a plexi-glass top, not to keep the rain out, but to keep it from becoming a very loud fog horn at high speeds. Size—10 inch diameter, height 20 inches, slot ½ inch wide, and as mentioned, the slot and top are filled with ¼" plexi-glass. There are 2 x 2 inch tuning tabs across the slot at the top. This keeps the height down to a reasonable level.

Tune up procedure is very simple—bring a grid-dipper coil up close to the shorted bottom of the slot. A good dip will be evident at the resonate frequency—adjust the spacing





of the tuning tabs for resonance at 146 mc. Attach 52 ohm co-ax—the shield to one side of the slot, the center conductor to the other side—start about 2 inches from the bottom. While checking the standing wave ratio on the feedline with a bridge, move the taps up or down on the slot for best match. Do not re-adjust the tuning tabs, attempting to match the line, for this gets you into a vicious circle. When the antenna is resonant, the impedance across the slot is resistive—zero at the shorted bottom, increasing almost linearly to prox. 1000 ohms at the top. When using co-ax to feed the slot, a balanced feed is obtained by dressing the co-ax snugly around the cylinder to the side opposite the slot, and bonding the shield braid of the co-ax to the cylinder at this point. In fact, the outer conductor of the co-ax may be bonded all the way around the side of the cylinder if desired.

When properly matched, check the radiation pattern with a field strength meter. You should find only horizontal radiation, uniform gain in all directions, and aprox 4 db gain over a dipole mounted in the clear.

The shortened Half Pylon Slot is ideal for 2 meter and up mobile operation, and mounted on a mast, well up in the clear, at the home QTH is a real pleasure to use. A beam is fine for DX, but is a pain in the neck for local operation. You just don't realize how many people are on these VHF bands until you have used a good horizontal non-directional antenna feeding a low-noise converter.

This antenna can be mounted many ways. The entire bottom, closed or open, is at zero rf potential as is the back area up the cylinder opposite the slot. If you fabricate the bottom plate of the cylinder of fairly heavy gauge metal, then a pipe flange or a TV mast clamp may be attached to the center, so that the Abe Lincoln may be top mounted on a pipe. The feed line may be brought down thru the pipe if desired; it can be installed inside the cylinder, slot, etc., just as described for outside. The Slotted Pylon antenna can be mounted with "U" bolts to the side of a mast or tower with some effect on the radiation pattern. The side away from the slot is placed next to the tower leg or mast. If a null in radiated pattern occurs, move the antenna around the tower to place the null in the least used direction.

The full slot version may be stacked for additional gain. Procure a pipe of the desired diameter and cut slots vertically up one side, one wavelength apart between centers, and feed all slots in phase. A 1926 mc. beacon antenna is currently being designed, 13 slots high, material is 1⅝ inch 52 ohm co-ax. Tentative data, in excess of 15 db gain—

Height—11 feet.

Horizontal directivity—±1 db 360 degrees.

Vertical directivity—approx. 15 degree beam width.

Feed Impedance—52 resistive at 1296 mc.

Apply leverage to W2NSD if full info is desired on this antenna.

In summary, the Pylon Slot and the shortened version fill a need in amateur communications systems. Many variations are possible, why not see what it will do for you, after all, a 20 meter unit is only 16 feet high and 6.4 ft. in diameter and set-up in your backyard would give the neighbors something different to discuss—as well as making you top dog in a WAC round table on SSB. . . . K2TKN

To the hundreds of Hams who have taken the time to write, we at EICO can only say...

FROM THE BOTTOM OF OUR HEARTS, THANK YOU

We promise to continue to do all in our power to merit your approval.

Milton Stanley
3909 High View Rd.
E. Peoria, Illinois

Electronic Instrument Co., Inc.
3300 Northern Blvd.
Long Island City 1, N. Y.

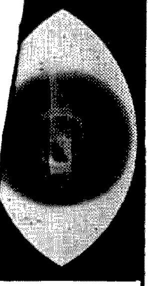
Dear Sir:

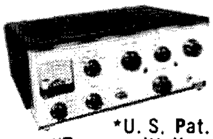
When I saw your Model 720 Transmitter on display, it looked so good that I decided to purchase a 720 kit. I put it together in five evenings. The instruction book is so well written that any beginner can build this kit with no trouble at all. When I put the 720 on the air for the first time, I called CQ and a station in Munising, Mich. answered me and gave me a 599 report. In two months I had worked 37 states with a single wire antenna about fifteen feet off the ground. All stations worked gave me a good report. I was so pleased that I purchased an EICO Model 730 Modulator. Results were equally good. I have worked 44 states and Canada on phone with the 720 and 730. All reports I get are very good. The clipping level control and the over modulation indicator helps make the EICO 730 Modulator the best buy for the money and I personally believe the EICO 720 Transmitter is the best 90-watt rig on the market. The EICO 720 and 730 together make an all around rig that is hard to beat. I am so well pleased with the quality of EICO kits that I am looking forward to building more of your products. I highly recommend EICO kits to beginners as well as the old timers.

Sincerely,

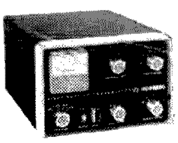
Milton Stanley

MILTON STANLEY, K9VJH

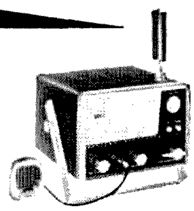




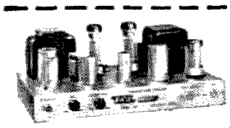
90-WATT CW TRANSMITTER* #720
Kit $79.95
Wired $119.95
*U. S. Pat. No. D-184,776
"Top quality" — ELECTRONIC KITS GUIDE. Ideal for veteran or novice. 90W CW, 65W external plate modulation. 80 through 10 meters.



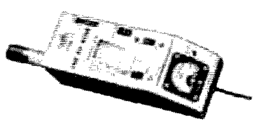
NEW! 60-WATT CW TRANSMITTER #723
Kit $49.95
Wired $79.95
Ideal for novice or advanced ham needing low-power, stand-by rig. 60W CW, 50W external plate modulation. 80 through 10 meters.



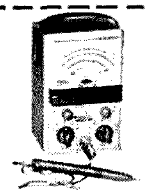
CITIZENS BAND TRANSCEIVERS
Single and Multi Channel Models Available.
From Kit $59.95 Wired $88.95



HIGH-LEVEL UNIVERSAL MODULATOR-DRIVER #730
Kit $49.95 Wired $79.95
Delivers 50W undistorted audio. Modulates transmitters having RF inputs up to 100W. Unique over-modulation indicator. Cover E-5 $4.50.

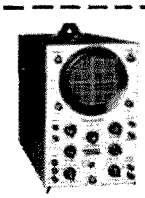


GRID DIP METER #710
Kit $29.95 Wired $49.95
Includes complete set of coils for full band coverage. Continuous coverage 400 kc to 250 mc. 500 ua meter.

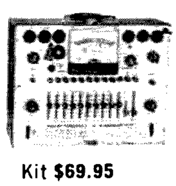


PEAK-TO-PEAK VTVM #232 & *UNI-PROBE®
Kit $29.95
Wired $49.95
VACUUM TUBE VOLTMETER #221
Kit $25.95 Wired $39.95

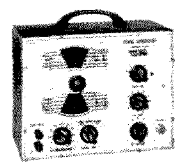
*U. S. Pat. No. 2,790,051



COLOR & MONO DC-5MC LAB & TV 5" OSCILLOSCOPE #460
Wired $129.50
Kit $79.95
5" PUSH-PULL OSCILLOSCOPE #425 Kit $44.95 Wired $79.95



DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666
Kit $69.95 Wired $109.95
TUBE TESTER #625
Kit $34.95 Wired $49.95



RF SIGNAL GENERATOR #324 (150kc-435mc)
Kit $26.95
Wired $39.95
TV-FM SWEEP GENERATOR & MARKER #368
Kit $69.95 Wired $119.95

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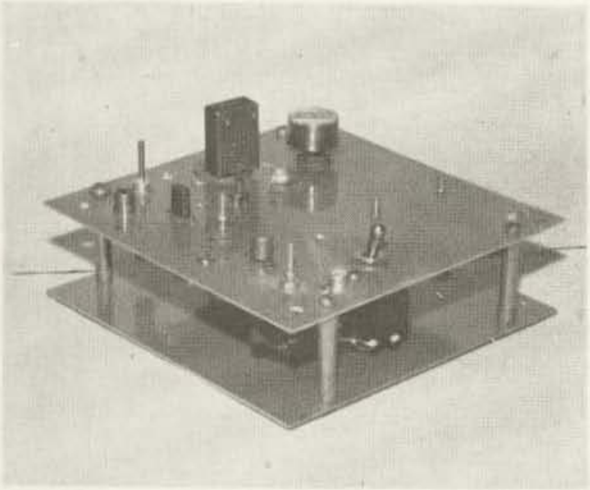


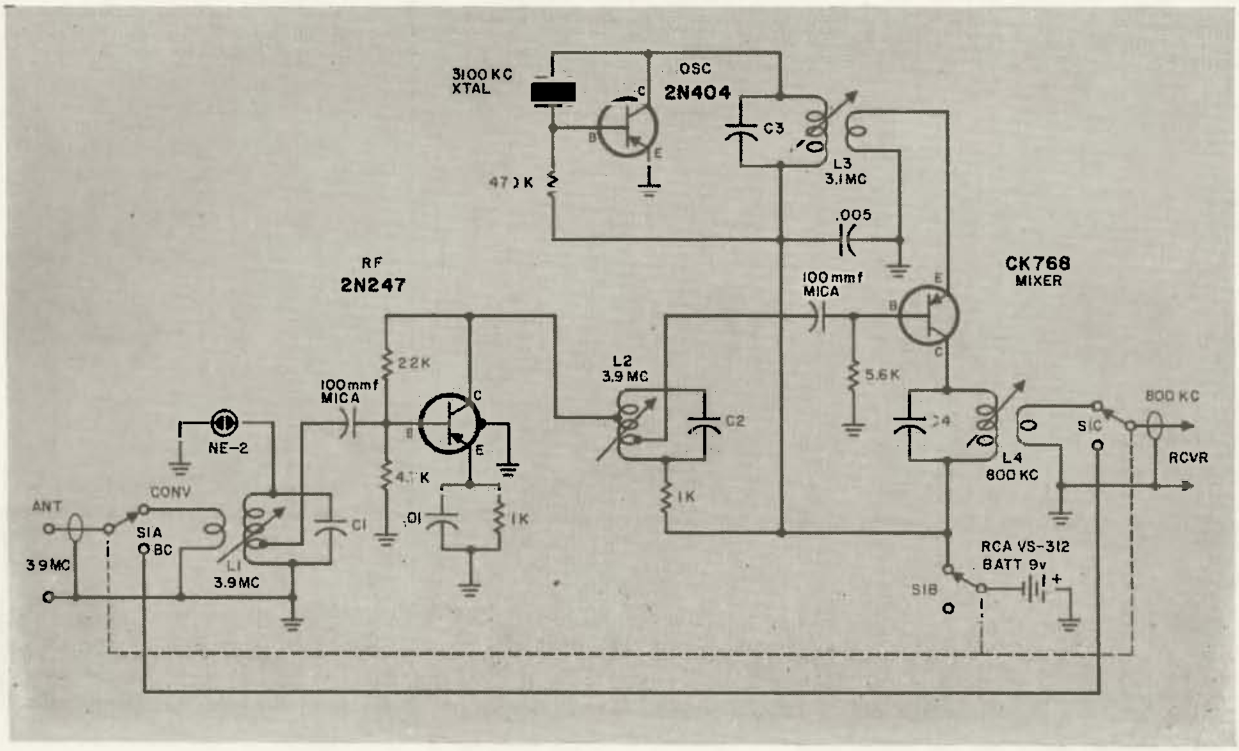
H. W. Johnson WA6DZL
1115 Molinar Ave.
La Puente, Calif.

75 Meter Transistorized Converter

I'VE tried several varieties of tube type converters for 75 meters, but none of them lived up to my expectations. Then I built a three transistor 75 meter mobile converter which has outperformed all of the previous tube types. Since it requires no B+ or filament voltage from the car radio it can be used with any existing auto receiver. It is presently installed in my VW and is performing excellently. The sensitivity is very good and my noise limiter has rarely had to be used.

Several types of transistors were tried. I found that though other (3 lead types) P.N.P. rf transistors worked well in the rf stage, they are not as satisfactory since there is much higher gain available with the drift types, such as the 2N247. The CK768 mixer, chosen mainly because of its low cost, worked well. Several types of transistors were tried in the oscillator and all worked quite well, including the 2N404, chosen here because of its low cost.

Wiring is not critical so long as leads are kept short. The use of sockets for the transistors is highly recommended. The oscillator was easily brought into oscillation and was first adjusted using a wave absorbtion meter and lastly, while installed in the car. RF and mixer coils were also peaked in the auto to approximately the center of the band (3.9 mc). An NE-2 neon light was installed across the input tank to afford some degree of protec-



tion against too much transmitter rf injuring the 2N247. A zener diode would of course provide even better protection. The crystal frequency was chosen only because I wanted to tune the 3800 to 4000 kc portion between 700 and 900 kc. Any other crystal frequency can be used to create the desired output frequency.

For the cost conscious, a comparison of prices taken from a leading catalogue house showed the three transistors to be considerably less in cost than suitable tube counterparts.

All in all this converter has been a most rewarding project.

Parts List

Crystal—Approximately 3100 kc (or from 2850 to 3200 kc).

C1 thru C3—Chosen to cause the coils to grid dip to the desired frequency.

C1-3—All were between 50 and 90 mmfd.

C4—360 mmfd mica or equiv.

L1—Wound on 1/4" diameter slug tuned forms. No. 30 enamel wire. Approximately 40 or so turns. Link is 4 or 5 turns close wound over cold end. Tap is 1/4 of the total turns up from the cold end. Grid dip to frequency.

L2—Same as L1 except, it has no link. Taps are 1/2 and 1/4 of the total turns, counted from the cold end.

L3—72 turns No. 34 enamel wire on a 1/2" dia. slug tuned form. Link is 5 turns on cold end.

L4—150 turns of No. 30 enamel wire on a 1/4" slug tuned form. Winding length was approximately 1 inch. Close wound in layer fashion. Link is approximately 8 or 10 turns close wound on the cold end.

L4—Alternate Miller—4514 with a 10 turn link wound on the cold end.

All tuned circuits were grid dipped. All of the wire was close wound on the forms. All capacitors C1 thru C4 should be mica or equiv.

Whipping Things Up

This is directed to you "mobileers." When you make a mobile installation, has it occurred to you that if the antenna (rear bumper mounted as most are) is on the *RIGHT* hand side of the car (viewed from the rear), you've got a better than fifty percent chance of trimming tree limbs, scaring old people and knocking off hats than if it were mounted on the LEFT hand end of the bumper?

That's right; mount the mobile antenna on the LEFT hand side of the car and you've got a clear area . . . right down the center stripe . . . without the possibility of lawsuit for scraping things and stuff which may overhang or come precariously near the edge of the OUTSIDE traffic lane!

More than that, you'll probably require a lot less maintenance than a RIGHT hand mounted (from the rear) antenna will call for. Give it a thought, Bud!

. . . W7OE

Precise Capacity Measurements

You can do it too

Captain John L. Reinartz USNR 'Ret', K6BJ
220 Mar Vista Drive
Aptos, California

To be able to make a capacity measurement down to a fraction of a micro-microfarad in the range from 1 mmfd to 300 mmfd is considered quite an achievement especially if you use equipment that most amateurs have in their hamshack. The least General Radio wants for such a bridge is $360.00 plus the cost of a number of accessories that may cost as much again.

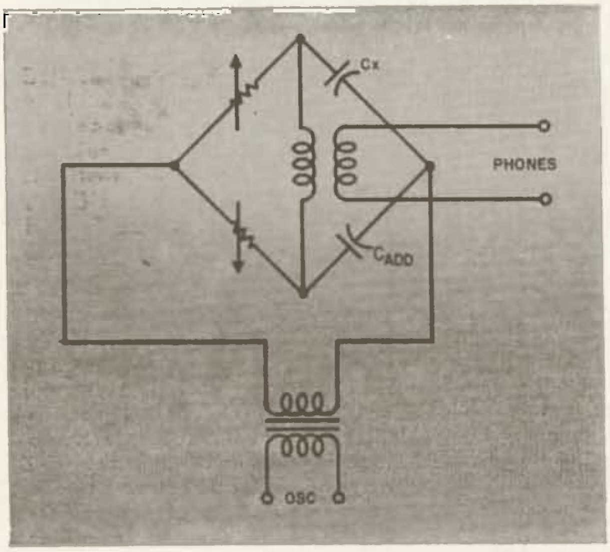


Fig. 1

The classic bridge that is fundamental in most commercial bridges is as shown in Fig. 1. Many refinements are built into this fundamental design when used for precision measurements, such as shielding of the standard condenser and the various other components including an output transformer to which earphones are connected. The trouble is that you have to go about buying at least the calibrated standard condenser. Even after you have it installed in your bridge you are no longer sure that the calibration has been maintained.

To overcome these problems and to be able to use a good garden variety of variable condenser as the standard, do away with the need for a 1000 cycle oscillator and the earphones, be able to measure to plus or minus 1 or 2 tenths mmfd, have no problem when connecting into the bridge because of lead capacity troubles and do this to the full extent of the capacity of the standard used, was the goal I set myself and was able to attain. The final circuit is shown in Fig. 2.

Let us start with a National Velvet Vernier Dial. The dial itself reads from 0 to 100 and the vernier gives us 1000 divisions. If we use a good broadcast receiver 350 mmfd straight line capacity condenser, and use it over that portion between 10 and 90 divisions on the National dial, we have about 300 mmfd that are useful to us spread over 800 divisions.

We balance the 300 mmfd with a fixed capacitor of a like value and thereafter forget it. All measurements are made by connecting the unknown condenser across the standard condenser and rotating the National dial toward a lesser value until we have again come to the original balance. The value of capacitance we reduced the standard to, will be the value of the unknown condenser. In the case just outlined, you will be able to read to plus or minus 0.2 mmfd, be it for a 10 mmfd or 300 mmfd condenser.

How do we know what the standard condenser calibration is? We go about it this way; let us suppose that we have an initial balance with the National dial reading just 90 divisions. We obtain a small fixed capacitor of say 100 mmfd and have it checked at some lab to a fraction of a mmfd. Let's say it reads exactly 98.6 mmfd. Obviously the original

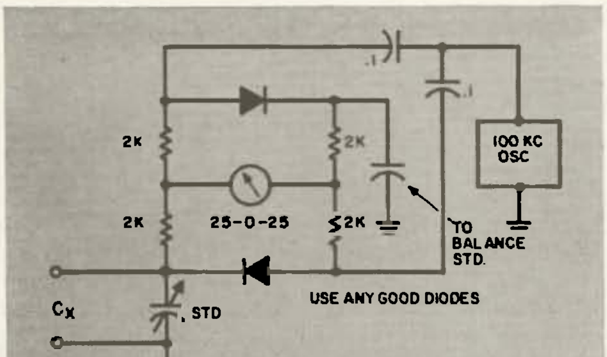


Fig. 2

balance is restored when the standard condenser is reduced by that same amount. If the dial and vernier read 57.1 the standard has a value of 3 mmfd per division and therefore we can read to 0.3 mmfd or plus or minus 0.15 mmfd. Having checked quite a number of straight line capacity condensers, these were all found to be remarkably consistent. Those condensers with ball bearings were of course the best.

100 kilocycles is the frequency used to actuate the bridge. A simple driver is shown in

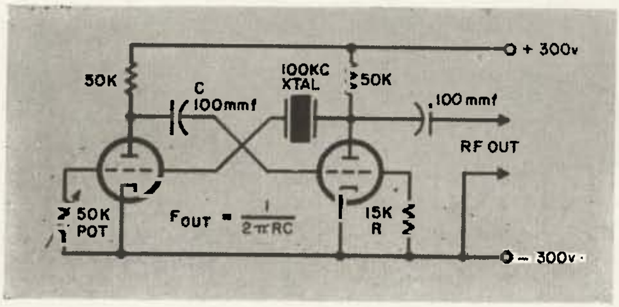


Fig. 3

Fig. 3. It is a simple multivibrator circuit and may be a free running type or it may be crystal controlled. If you have one of the old style 1-inch square crystals you will find that no matter what its frequency is as the fundamental frequency, it will also because of the 1-inch dimension operate at close to 100 kc in a multivibrator circuit. This will hold the frequency quite constant and will result in a stability that will hold for hours at a time.

The resistors are 1 watt rating and four as near in value as can be obtained should be used. The meter is a 25-0-25 micro-ammeter. If you are good at such things, bend the needle edgewise for greater ease of reading the same point at zero. Those who have a L&N Students galvanometer should use it. The accuracy of the reading will be improved due to the suspension type of movement as against the pivot type in the first mentioned meter.

Whenever a condenser needs to be measured and leads several inches long have to be used, these leads are first connected to the standard and are so adjusted that they will not be changed in configuration when attached to the unknown condenser. The lead capacity can be read from the change necessary to the standard reading and the new reading is then the one used to subtract the final reading from when the unknown has been connected and a balance has been obtained. Suppose the normal balance is always 94 div. on the dial. With leads connected a new balance is obtained at 89 div., and with the unknown connected it is 50 divisions. Since in our case the standard has a value of 3 mmfd per division, we find that 89 minus 50 times 3 is the capacity value of the unknown and in this case is 117 mmfd. In this manner any lead value is obviated.

If known values of fixed capacities are added to the balance condenser, the range of the device can be extended as desired. The known additional value is then added to the value obtained from the dial reading.

If that part about having a lab check out your 100 mmfd condenser has you stumped then perhaps we can make a deal. I'll test the value of any 100 mmfd postage-stamp size fixed condenser for anyone that sends me a self-addressed stamped envelope and 25¢ along with the condenser. I am using a General Radio type 722 Precision Condenser in the circuit, so I can give good precision. . . K6BJ

Part II

Propagation

David A. Brown, K2IGY

LAST month in Part I, I covered the Sunspot Cycle and gave a prediction of smoothed numbers for the remainder of the cycle which I think will have its minimum by June 1964. Part II is going to cover the different variations in MUF by presenting a circuit analysis of the path New York to England along with a SPECIAL PROPAGATION CHART for the coming Winter season, 1961.

The MUF (Maximum Usable Frequency) is the highest frequency that will propagate at a given time between two points of communication, and any frequency higher than the MUF will not reach the other end of the circuit. Frequencies below the MUF (especially those lower by a factor of 2 or more) require an excessive amount of power to give satisfactory signal to noise ratios. The MUF for any given circuit varies with the time of day, season of the year and with the Sunspot Cycle.

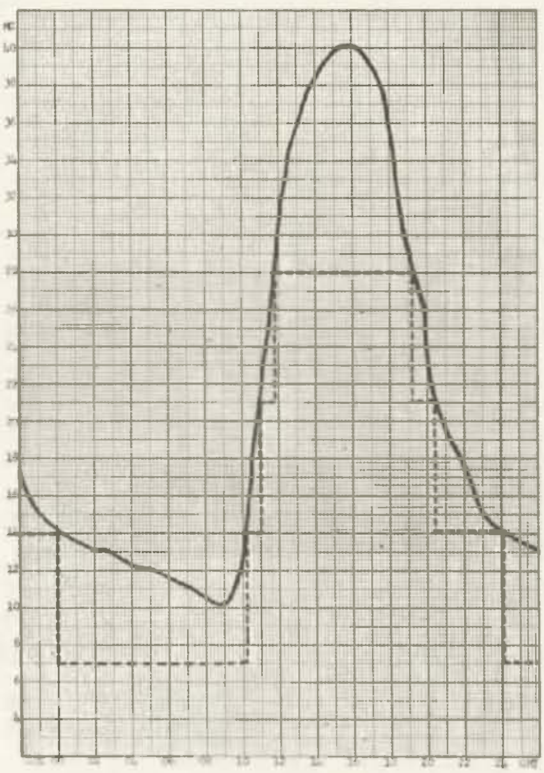


Fig. 1

Fig. 1 illustrates the Diurnal variation in MUF along with the Ham Band Frequencies (HBF) that should be used. During the nighttime hours the MUF's are quite low and the HBF is the 40 meter band. As soon as the Sun rises however, the MUF rises sharply to a maximum following the zenith angle of the Sun and then falls back down again as the Sun gets lower in the sky. Notice how the HBF follows this curve. It is this plot of the HBF that appears each month in the Propagation Chart for each of 42 different paths. What is important to note is that the MUF and HBF varies with the rotation of the Earth on its axis and with the angle of the Sun in the sky, and that moving from one HBF to another is a jump by a factor of two which means that the HBF for the time given is the best frequency that we can use for hamming.

Besides the daily variation in MUF there are Seasonal variations and these are shown in Fig. 2 and Fig. 3. Here we see that the diurnal variations are different for each month of the year. First, notice that (Fig. 2) the Sunspot number is decreasing as the maximum value of MUF for each month decreases as we go from Winter to Summer. Next in Fig. 3 we

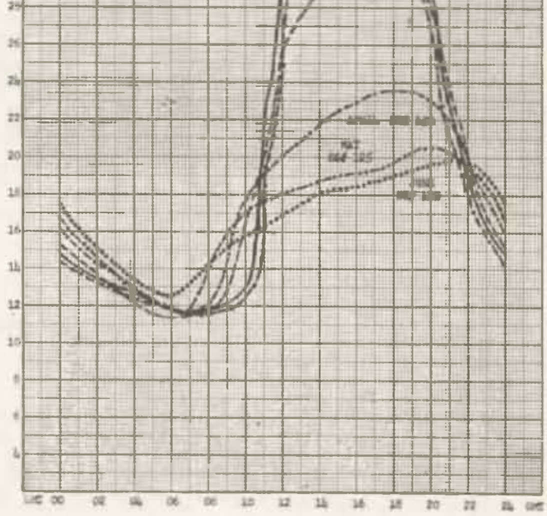
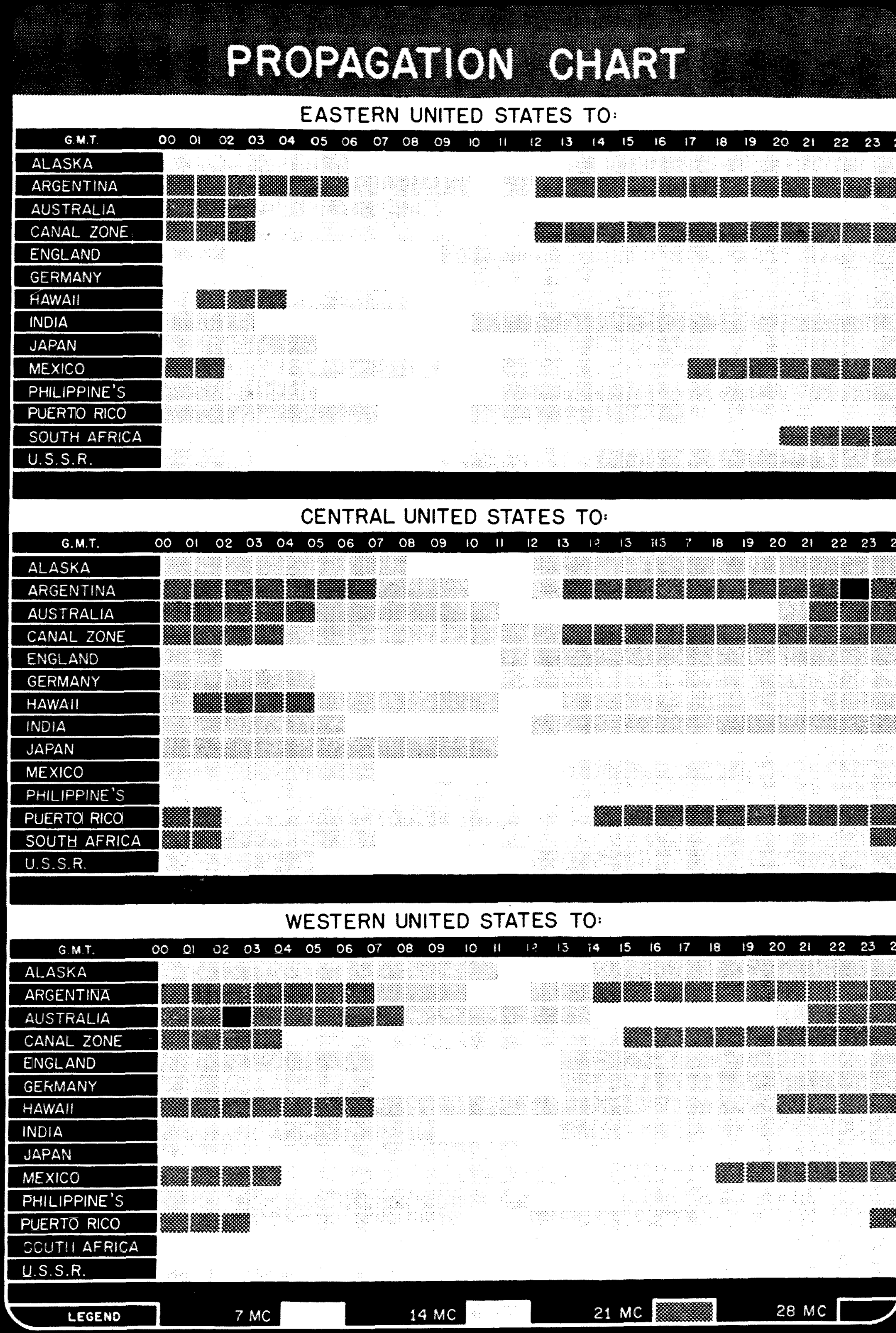


Fig. 2


PROPAGATION CHART
EASTERN UNITED STATES TO:
G.M.T.
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PUERTO RICO
SOUTH AFRICA
U.S.S.R.
CENTRAL UNITED STATES TO:
WESTERN UNITED STATES TO:
LEGEND
7 MC
14 MC
21 MC
28 MC

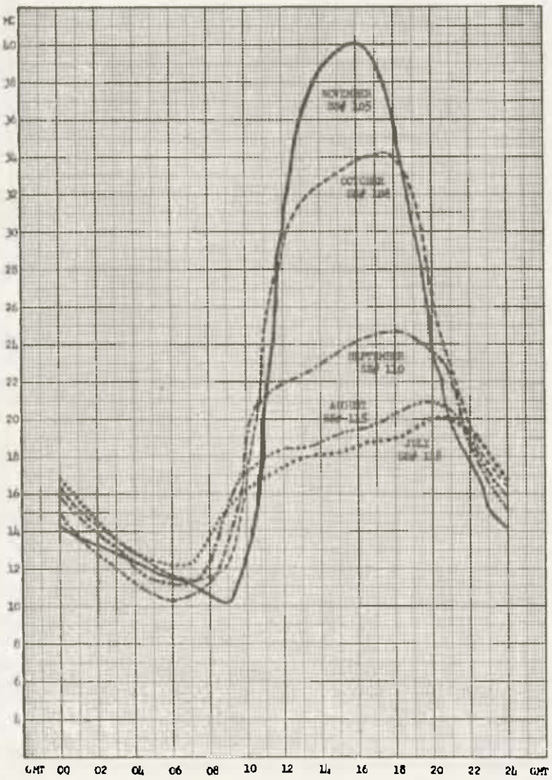


Fig. 3

see that the maximum value of MUF in the diurnal curves is increasing from Summer to Winter as the Sunspot number is still decreasing! This is the Seasonal variation in MUF which is independent of an increasing or decreasing sunspot number. Notice too that the nighttime Winter frequencies are lower than the Summer nighttime frequencies and that the Winter daytime frequencies are higher than the Summer daytime frequencies. It can also be seen that the highest MUF is reached later in the day in the Summertime than in the Winter.

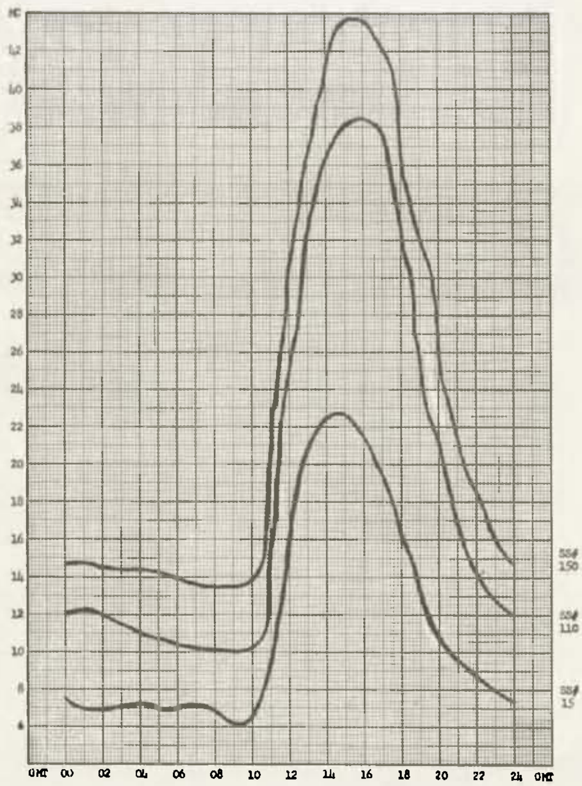


Fig. 4

The seasonal curves can be placed into three basic groups, each group containing a basic type of curve covering four months as follows: Winter Season—November, December, January and February; Equinox Season—March, April, September and October; Summer Season—May, June, July and August. These basic curves are shown in Fig. 4, Fig. 5 and Fig. 6 along with the Cyclical variation with sunspot number.

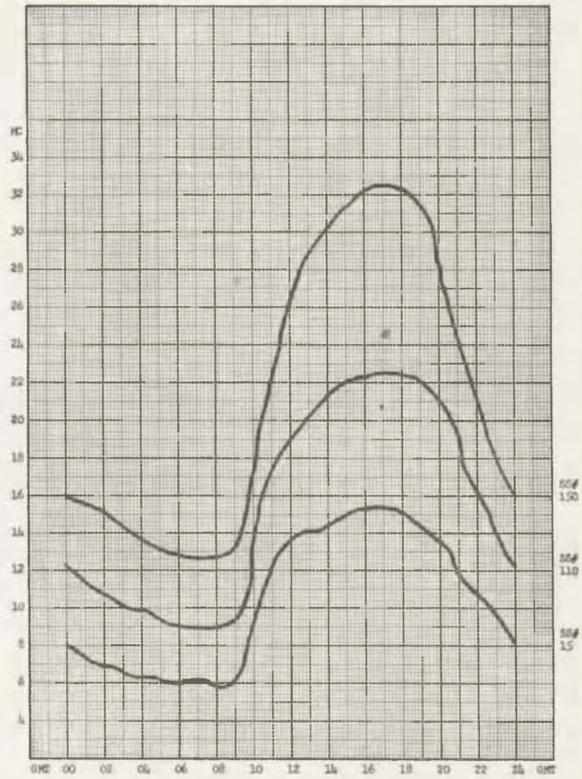


Fig. 5

In Fig. 4 the highest HBF is 28 mc and this is reached when the sunspot number gets into the fifties. The lowest HBF is the 40 meter band until the sunspot numbers get as low as fifteen or lower, when the 80 band is the nighttime HBF. From this set of curves we can see that there should be some 28 mc activity this Winter, if the sunspot numbers follow those predicted in Part I, for the New York to England path.

From Fig. 5 we can conclude that there will be no 21 mc openings in September and that during the daylight hours the best HBF will be 14 mc and at night 7 mc. Towards the end of October when the transition from the Equinox curve to the Winter curve comes, is when we will find the first 21 mc openings to England.

(Turn to page 59)

73 Tests

The Electrotone M-100 Gate Modulator

Charles E. Spitz W4API
1420 S. Randolph St.
Arlington 4, Virginia

If you are the average ham, or more active than average, you may have passed this unit by without thinking too much about it filling a place in your hamshack. After all you may have everything. Well, *almost everything!* I admit seeing the advertisement in the November issue of 73, but since it talked mainly about commercial or home brew CW transmitters, and having no such plans at the time, my curiosity was not sufficiently aroused. Actually, there are many more applications for the M-100 around the average shack than the advertisement implied, whether as a part of the main transmitter or as an adjunct to other projects.

This is a completely self-contained audio system from mike input to modulator output with internal power supply, weighing only five and one half pounds in a compact cabinet about 5x6x7 plus in size, and containing clipping, filtering, over-modulation insurance, carrier control and even a 1000 cycle audio generator to take care of the whistlers!

Since the M-100 is designed to be inserted electrically in your amplifier screen, it obviously is limited to applications where screen grid tubes are used, and where a screen voltage of 400 or less would apply. This is not much of a hardship, since screen grid tubes are the most commonly used in transmitters and amplifiers. There is nothing tricky or difficult in hooking up the unit or operating it. Of course your transmitter must have the stability which is required of all good phone operation. Although CW needs stability too, defects show up more readily when any rig is modulated. Everyone on phone should occasionally turn on a bfo just to see how many rigs are wobbulating while modulating!

There is nothing in the M-100 which of itself would cause such untoward effects, and in fact there is a distinct advantage in it's

Application: To modulate CW transmitters or linear amplifiers. Used with Tetrodes or pentodes, single, parallel or push-pull in the range from 10 to 1000 watts, where 400 volts or less is required for the screen.
Size: 6½"x7½"x5¼"
Weight: 5½ lbs
Power: 115/230, 50/60 cy, 30 watts
Input: Crystal or dynamic mike
Bandpass: 300-4000 cycles
Tone: 1000 cycle generator
Limiting: Speech clipping, negative and positive peak over-modulation prevention
Output: 400 peak dc volts maximum, 40 ma instantaneous dc current
Guarantee: Two years including replacement of parts and labor; tubes for 6 months
Net Price: $49.95, delivered in U. S.
Manufacturer: Electrotone Laboratories, 2717 North Ashland Ave., Chicago 14, Illinois
Controls: On-Off Switch, Modulation Level Control, Carrier Level Control, Tone Generator Switch, CW-Phone Switch

low power requirement even when modulating a high power transmitter due to the absence of line voltage fluctuation caused by high level class B modulators reacting on a VFO.

The series gate modulator system was described in the November 1, 1957 issue of Electronics, and in the R.S.G.B. Bulletin of May 1959. The manufacturer also publishes an excellent brochure giving a detailed technical description of the circuit operation, for which he should be commended, and which is available to all who write.

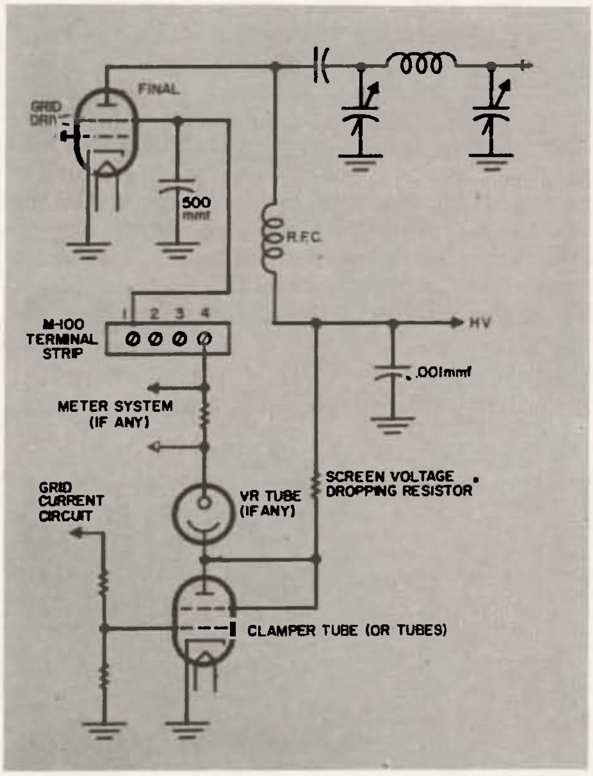
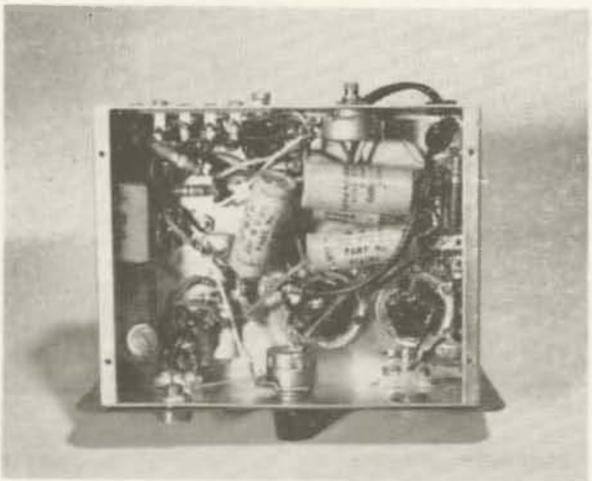


Fig. 2

Note the schematic diagram in Fig. 1. The operation is best stated in terms of dc and ac state consideration. For the dc state, if the grid of V-3A is biased to the cut off point, then the full B plus potential appears on the plate and is direct-coupled to the grid of V-3B. V-3B conducts fully and the voltage drop across the cathode resistor R-15 is applied to the final's screen. Hence, a full rf carrier is obtained. As the slider of the carrier control potentiometer is moved towards the cathode side of V-3A, the bias on the grid diminishes and V-3A starts to conduct, resulting in a voltage drop across its plate load resistor R-14. The reduced voltage appears on the grid of V-3B and reduces the plate current of V-3B proportionately. Hence, the positive potential applied to the final's screen is reduced and rf carrier level is low.

In considering the ac state, with the bias on the grid of V-3A set by the carrier level control to approximately 1 volt negative, the dc

(Turn to page 22)



voltage applied to the final's screen is low, and therefore the rf output is low. If an audio voltage of 1 volt peak is now applied from V-2 to the grid of V-3A, it will be amplified by V-3A and appear through V-3B at the screen of the final and will modulate the low rf output approximately 95%. The mean dc potential of the final's screen remains constant. If the audio voltage applied to V-3A is increased, grid current will flow in V-3A. A negative charge will build up on C-9 proportionately to the peak amplitude of the applied audio. This additional dc bias applied to the grid of V-3A will cause the potential on the plate of V-3A and the grid of V-3B to rise. The mean screen potential of the final will rise too, resulting in increased rf output.

The increased audio voltage at the grid of V-3A will appear as an amplified voltage at the final's screen relative to its previous level, but as the mean screen potential has also been raised the rf carrier is again modulated approximately 95% and no over-modulation occurs.

The bias on V-3A will increase until a limiting condition is reached where the bias built up on the coupling capacitor C-9 cuts off V-3A. No further audio voltage can reach the final's screen, the dc potential of which is at maximum; thus positive over-modulation is prevented. Negative peak over-modulation is prevented because the dc screen potential of the final can never fall below the level selected by the carrier control potentiometer; the audio voltage can only modulate this screen dc potential to produce full modulation.

Effective speech clipping is obtained by increasing the audio voltage input above the level that will produce approximately 95%

(Continued on page 49)

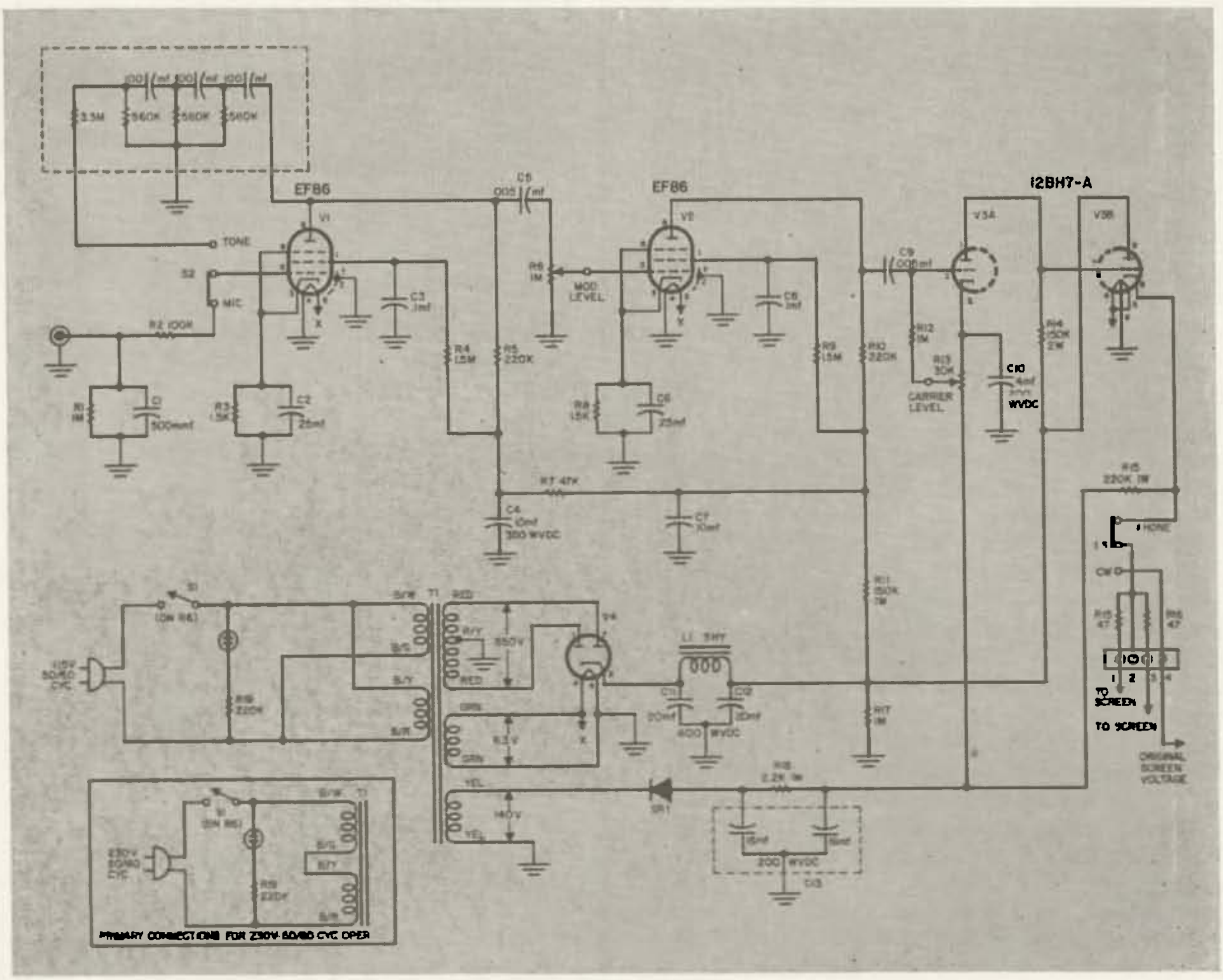
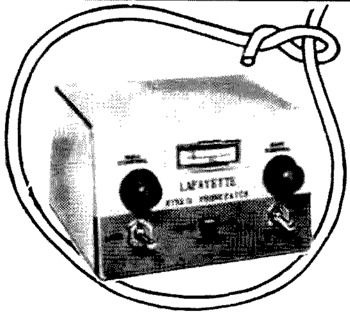


Fig. 1

THE LAFAYETTE ROUNDUP OF HAMSHACK VALUES



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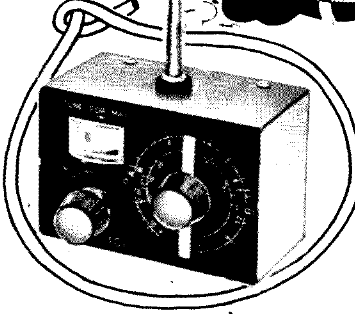

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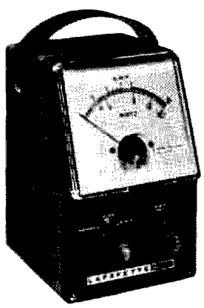

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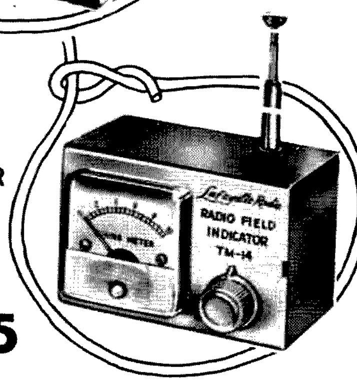

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Complete, no wires to connect. Monitor transmitter output, check antennas, etc. Perfect for mobile, provided with magnetic feet.

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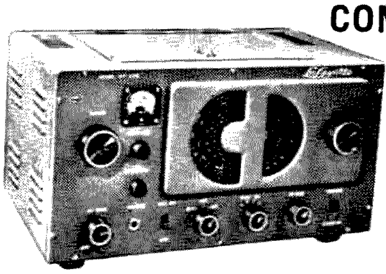

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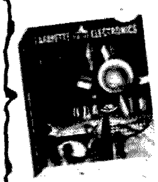

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A Universal AM Monitor

James L. Tonne W5SUC
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HERE is a high quality modulation monitor that will give a dependable indication with any mode of AM transmission. It responds to the positive peak value of rf output, regardless of whether conventional or suppressed carrier transmission is employed. Or, at the flip of a switch, it will indicate average output. The detected envelope is available for oscilloscopic observation, and an audio amplifier provides an output for headphone monitoring. The metering, oscilloscope and audio circuits are electrically isolated and non-interacting.

In conventional monitors, the carrier must be present in the usual amount. Such a monitor is relatively easy to fabricate. To the author's knowledge there has been no data published on a monitor which will successfully operate on a suppressed or partially suppressed carrier signal. Suppose you're operating a phone transmitter using single or double sideband, and decide to crank in some carrier for an uninitiated fellow on the other end. How much carrier to insert usually remains a mystery. The usual modulation monitor won't help you in the least in such a situation.

All this comes about when the necessary audio amplifiers or transformers used to drive the meter circuit are considered.

The typical monitor as published in the amateur literature has another serious defect: it responds to average modulation level, not the peak. Hence it is waveform-sensitive in that the indicated reading will vary over wide limits depending not only on percentage modulation, but also on waveform. The rf envelope must have its *peak* value measured if the monitor is to have any real value.

An oscilloscope output should be provided for waveform observation. It should not disturb the rest of the circuitry. This feature is lacking in most monitors. Lastly, it is advisable to have a built-in audio amplifier to drive a pair of headphones. This allows plenty of freedom in choosing the headphones without worrying about adequate volume. Again, this amplifier will provide isolation between the phones and the rest of the circuitry.

Circuitry

The block diagram of this monitor is shown in Fig. 1. The arrangement of components is probably a bit unusual, but each stage does its intended job and does it well.

At the input is a variable attenuator. This is a panel control, used as a sort of calibration or sensitivity control. It is not frequency sensitive, so changing bands with the transmitter will require no gross readjustment.

Following this is the detector. A 6AL5 was used instead of a crystal diode because the

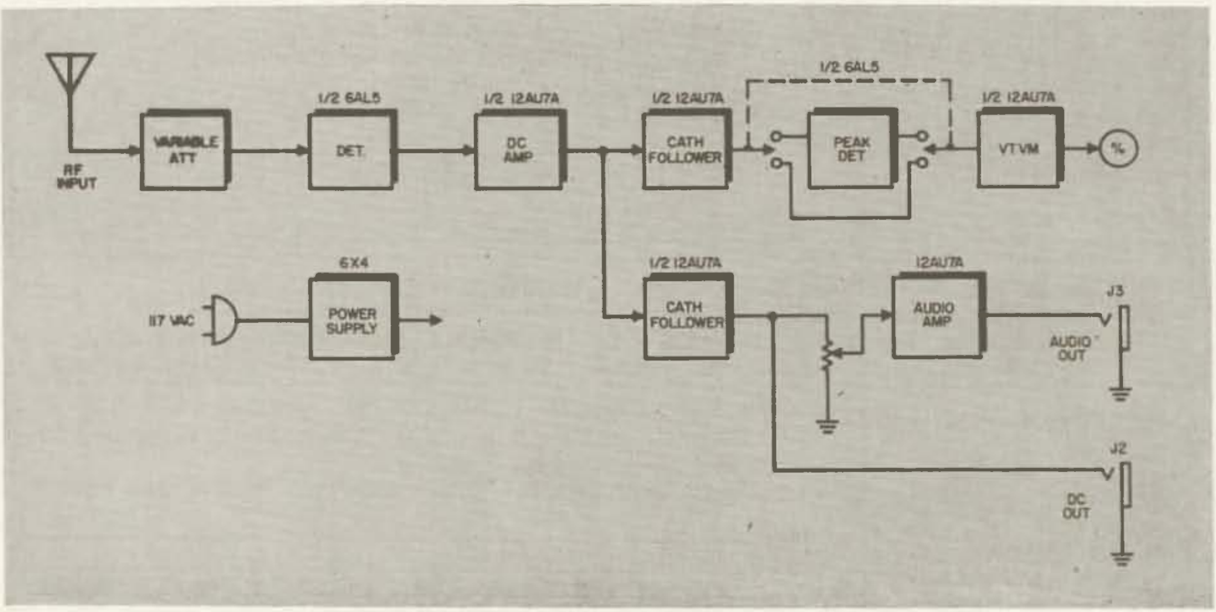
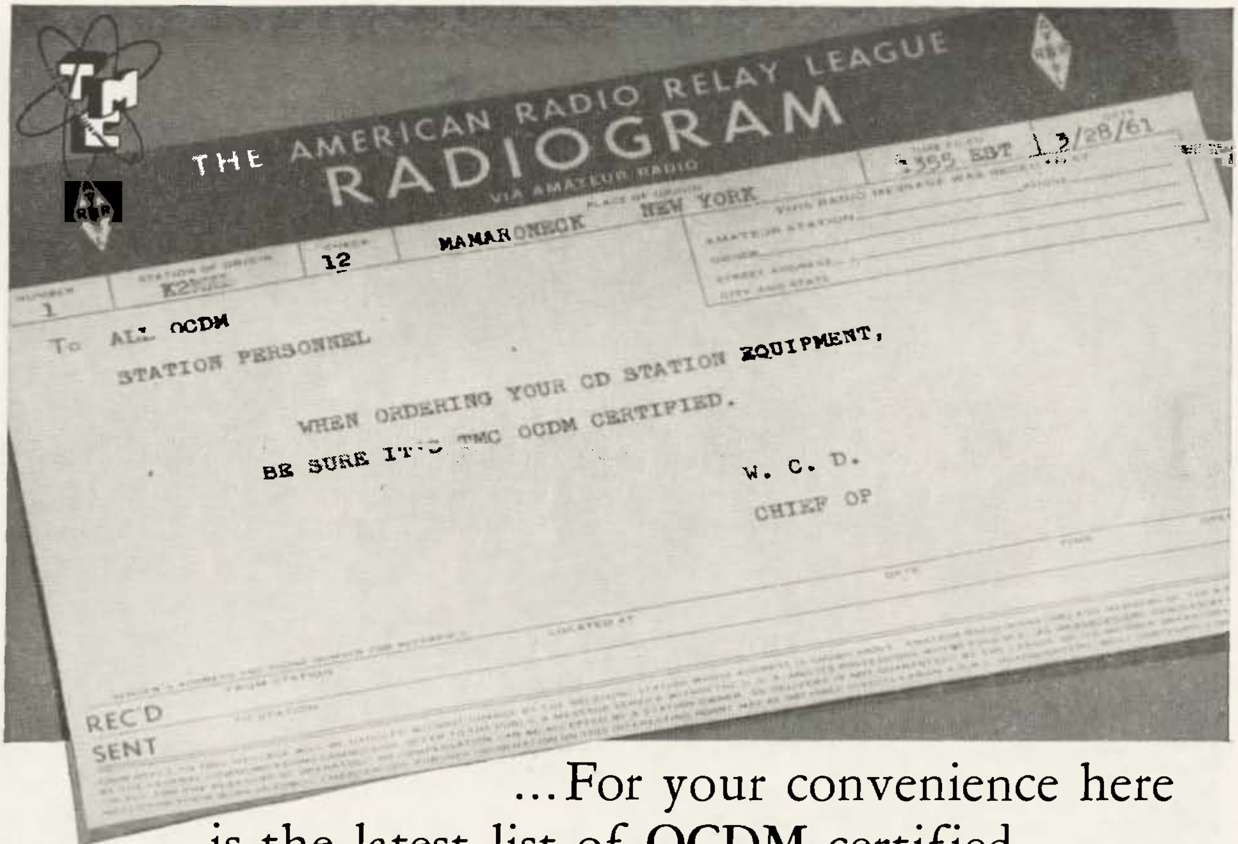


Fig. 1



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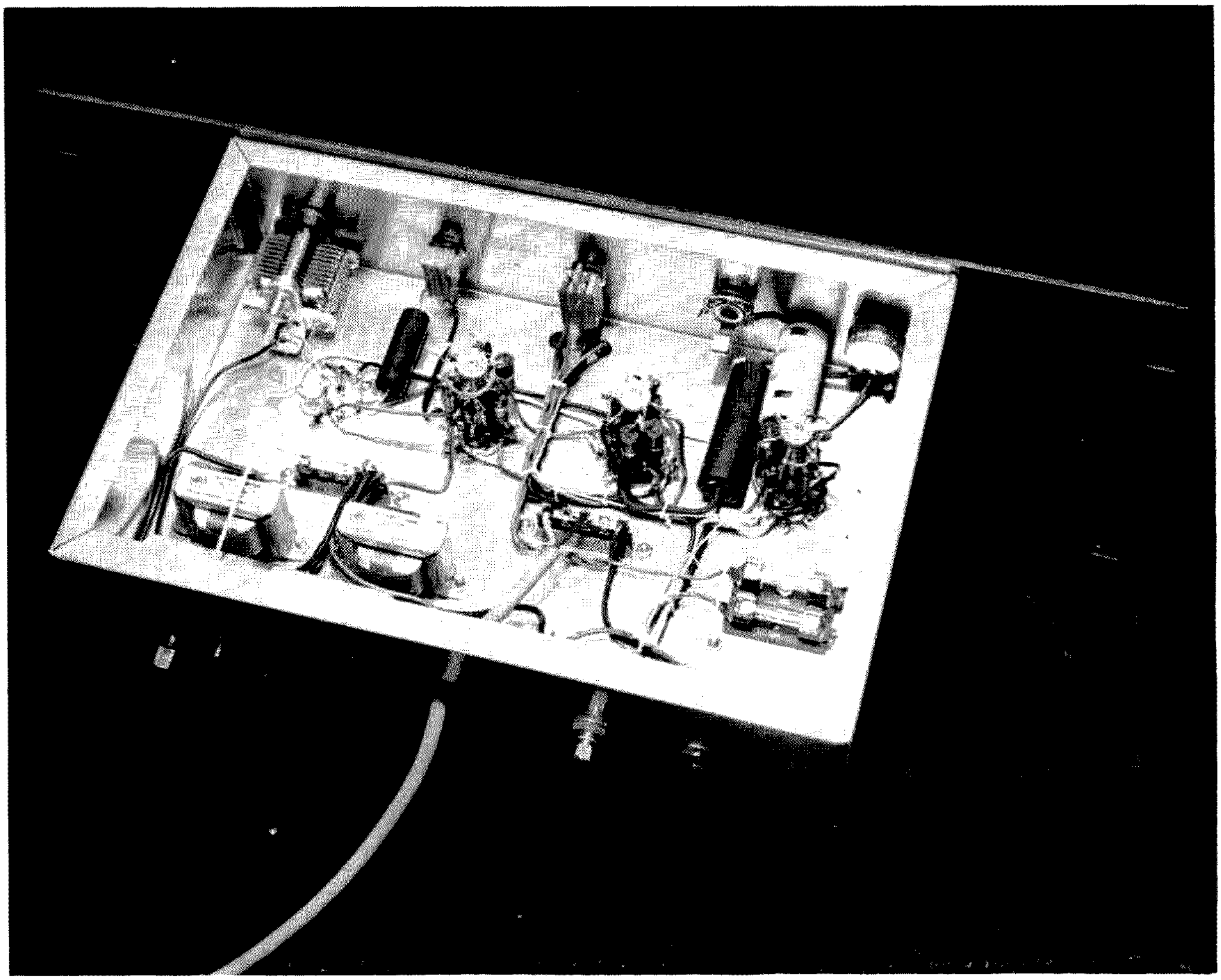


thermionic type is a bit more rugged. A bit of rf filtering and the detector output becomes the transmitter output envelope. This signal is fed right into the grid of the dc amplifier. No blocking capacitor is used nor needed.

The amplifier feeds a peak detector—but a cathode follower separates the two for isolation. This also allows the peak detector to respond very accurately to the actual waveform peaks. A simple VTVM rounds out the metering circuit.

The dc amplifier also feeds a second cathode follower, whose output is intended to go to an oscilloscope for waveform observation. It might be of interest to note that from the detector right on through to the scope output, everything is direct coupled. Hence a dc scope can be used for additional information. If such a scope is used, the trace will not bounce around the screen even with suppressed carrier or cw operation.

The scope cathode follower also drives a gain control, which selects the desired quantity of audio for the audio amplifier.

A small power supply using a 6X4 completes the picture.

Details

C1, in conjunction with C2 forms a variable capacitive voltage divider. C3, R1 and V1a form the detector. A ceramic socket is used for V1 to minimize rf losses. R2 in conjunction with the input capacitance to V2a forms an rf filter. R3 is the plate load for this stage, the dc amplifier. Its rating is two watts in the interest of stability, important at this point. This tube operates at zero bias, with the input signal providing the proper (negative) grid voltage.

The output of this stage feeds both V2b and V3b. Each of these latter stages are connected as cathode followers. In the case of V2b this is done in order to prevent loading V2a while at the same time providing a low impedance charging path for the peak-measuring circuit (V1b, C4 and R7). The result of using this circuit is that C4 will charge to the positive (maximum) peak of the incoming signal to within 1% at the end of 3 milliseconds. High accuracy is thus assured on peak readings, regardless of the modulating waveform.

If S1 is opened ("Average" position), C4 is out of the circuit, and the unit will then read the average value of the transmitter output.

R6 is a plate current limiting resistor to keep the plate dissipation or plate current ratings of either V2b or V1b from being exceeded if either of these tubes should develop a heater to cathode short. Thus, the trouble will be kept localized and will not destroy further components. This resistor has no appreciable

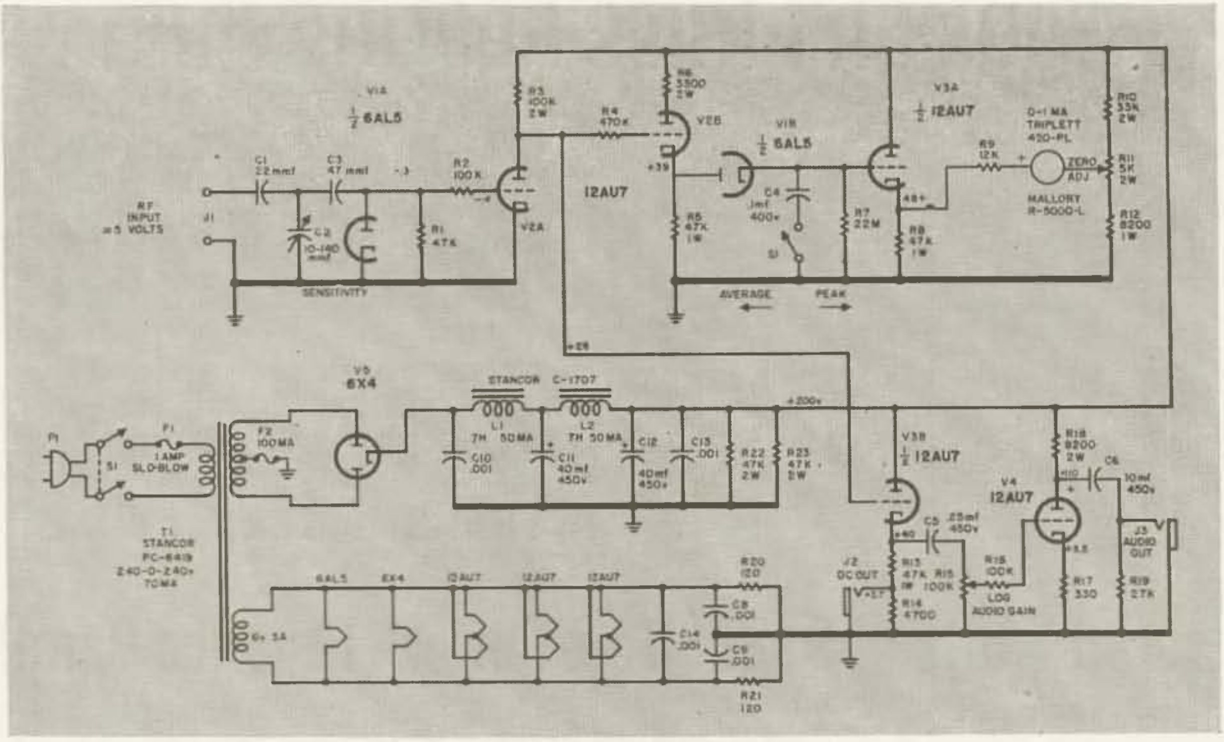


Fig. 2

effect on normal operation.

On extremely fast-rising inputs, V2b may have a tendency to draw grid current on the peak portion of the waveform. R4 prevents this effect from loading V2a.

The output of the peak-measuring circuit is fed into the voltmeter using V3a. This again is a cathode follower, to prevent loading the preceding stages while at the same time delivering sufficient current to operate the meter. R11 is the balancing adjustment for the meter, and is a rear-of-chassis screwdriver type. It is smooth in adjustment but has more than sufficient range.

The dc amplifier, V2a, drives a second cathode follower, V3b, which provides a low impedance source to operate the gain control, R15. R16, in conjunction with the input capacity to V4, prevents stray rf from activating the audio amplifier. C7 blocks the dc in the plate circuit from appearing on the load, presumably a pair of headphones. A large value of capacitance is needed here to maintain good low-frequency response. R19 drains off any leakage through C7.

A portion of the output from V3b is tapped off and delivered to J2. The output here is about 2 volts with a dc bias which is not particularly harmful. This output is intended to go to a scope for a visual indication.

A power supply every bit as conservatively designed as the rest of the circuit is integral with the unit. A 6X4 rectifier is employed to prevent damage to the meter circuit by a quick-acting power supply. The rectifier socket is of ceramic to prevent possible trouble from heating. The dc output is filtered by a two-section choke-input filter. Due to this filtering, the signal to noise ratio in the circuitry is in excess of 60 db. Extensive rf filtering is incorporated. The primary is fused with a 1 amp slo-blo fuse, and the high voltage winding additionally has a 100 ma fuse. The filament circuit has rf bypassing and a "resistive" center tap is used for minimum hum.

Initially . . .

Turn the unit on, allow a few minutes for the tubes to stabilize, and set R11 for zero meter reading. A few feet of wire attached to the "hot" input terminal will probably pick up sufficient rf to operate the device.

Bear in mind that this unit is basically an rf voltmeter, with a sensitivity such that about 5 volts or so at the input will cause full scale deflection. With S1 in the peak position, the unit will indicate the peaks of the applied input. With S1 in the average position, the meter will indicate the average value, which is always lower, regardless of modulating waveform.

With suppressed carrier transmission, no modulation will result in no transmitter output and resultant zero meter reading. With modulation applied, the meter will read up

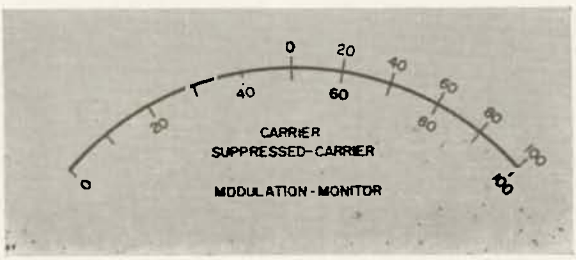


Fig. 3

scale. It will indicate peak or average according to the setting of S1. Normal procedure would be to drive the final transmitter stage to maximum linear output, as indicated on the scope, and set C2 (Sensitivity) so the meter reading is full scale with S1 in the peak position. Then the average output can be read by switching S1 to the average position.

With conventional modulated carrier transmissions, the meter reading (half of full scale, set with C2) will be the same with or without modulation if S1 is in the average position. With S1 in the peak position, the reading will double with proper modulation. Hence the scale calibration will be as in Fig. 3.

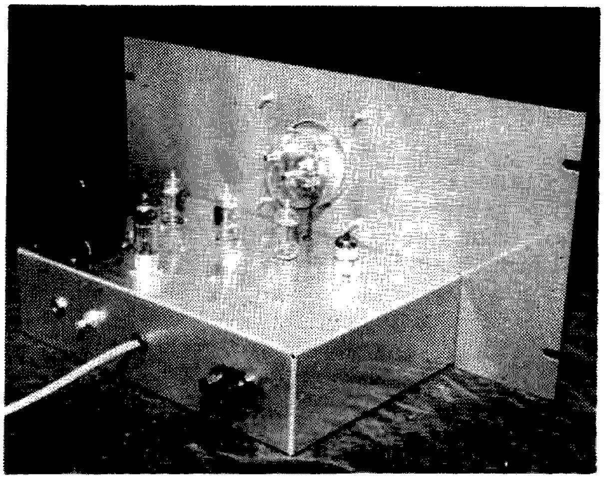
If reduced or partially reinserted carrier operation is contemplated, set sensitivity (using C2) so peaks (S1 in peak position) are at full scale. The proper amount of carrier to insert is then that which is sufficient for half scale deflection.

Note that when measuring modulated carrier transmissions, only the positive peaks are measured. This is no serious drawback, and does not penalize one if high level negative-peak clipping is used.

The audio circuitry will behave as any diode detector; it will function best when modulated carrier transmissions are used. It is, however, useful to tell aurally what kind of noise might be on a signal of any kind. The scope output is usable under all conditions, including analysis of c.w. emissions.

. . . and Finally

All parts in the device are standard and can be obtained by mail. Recommended or unusual types are indicated in the parts list. The vol-



tages indicated on the schematic are dc voltages measured with a VTVM. But have no fear: the circuitry is sufficiently conservative that the device should continue to work even though the tubes are about to fall out of their sockets.

Figs. 4 (Audio Frequency Response) and 5 (Meter Circuit Response) show the accuracies of the more important circuits in the unit.

. . . W5SUC

Don't Break Those Good Taps

After you break a few good taps with the "old tap buster" (hand tap wrench) try using self-tapping screws on sheet metal chassis and other light metal parts. It is often much easier to tap threads in holes for mounting parts than to struggle and swear while you try to get the blasted little nut started on that screw down in the corner.

Self-tapping screws are hardened and have tapered tips with either a short lengthwise slot or a fluted tip. They have four common types of heads: hexagon; slotted hex; slotted round and Phillips. If you don't have some samples in your junk box you can get a handful from larger hardware, auto supply stores and most sheet-metal shops. A fair assortment should only cost about as much as one tap.

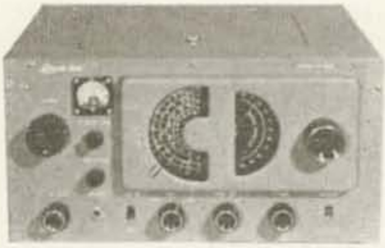
They are quite easy to use in steel up to #16 gauge which is .0625" thick; and in aluminum to ⅛" in thickness.

Common sizes for radio work with drill hole sizes for tapping steel to 1/16" thickness are:

Size screw	Drill Size Steel	Drill Size Aluminum
4-40	#39	#42
6-32	32	33
8-32	29	30
10-32	24	27

Put a speck of lard, grease or cutting oil on the screw tip before starting it in steel. I prefer the slotted-hex type, as I start them with a screwdriver, then finish with a socket nut driver. The self-tapping screws will substitute for taps in steel about 6 to 10 times, and in aluminum or brass almost indefinitely.

. . . J. J. Marlatt, K7AGI



Modifying the Lafayette KT-200 Receiver

William I. Orr W6SAI
48 Campbell Lane
Menlo Park, California

IT TAKES a pretty keen eye and plenty of "know-how" to buy a good communications receiver for under one hundred dollars. Sure, there are some sets on the market selling for much less than that amount, but most of them only qualify as toys. Low in sensitivity, wide in bandwidth, and poor in stability, these receivers serve to introduce the newcomer to shortwave radio. After that, the receiver has served its purpose, and the ham or listener is ready to "step up" to a more advanced type of receiver.

What should the "minimum communications receiver" offer the buyer? Well, it should have an rf stage to provide usable sensitivity on the 10 meter band. It should have two *if* stages to produce a reasonable degree of gain, it should have an S-meter, and it should have a voltage regulated power supply for the high frequency oscillator. In addition, it should have the usual trappings, such as a bandspread dial, beat oscillator, headphone jack, standby switch and other operating aids.

Does such a receiver exist for under one hundred dollars? The answer must be a qualified "no." The author is always waiting to be shown such a jewel, but so far the wait has been in vain. However, there have been some close contenders for this interesting bargain, and one of the best of them is the Japanese-made, KT-200 communications receiver, sold by the *Lafayette Radio Co.* of New York. This article describes simple modifications to this receiver which make it serve as a very acceptable ham receiver, or general purpose shortwave receiver.

The KT-200 Circuit

A block diagram of the KT-200 is shown in Fig. 1. The receiver covers the 550 kc to 30 mc spectrum in four bands. It is rugged, well made, and uses good components. After several months of casual operations at W6SAI the receiver seemed sufficiently stable and sensitive to expend some additional effort in

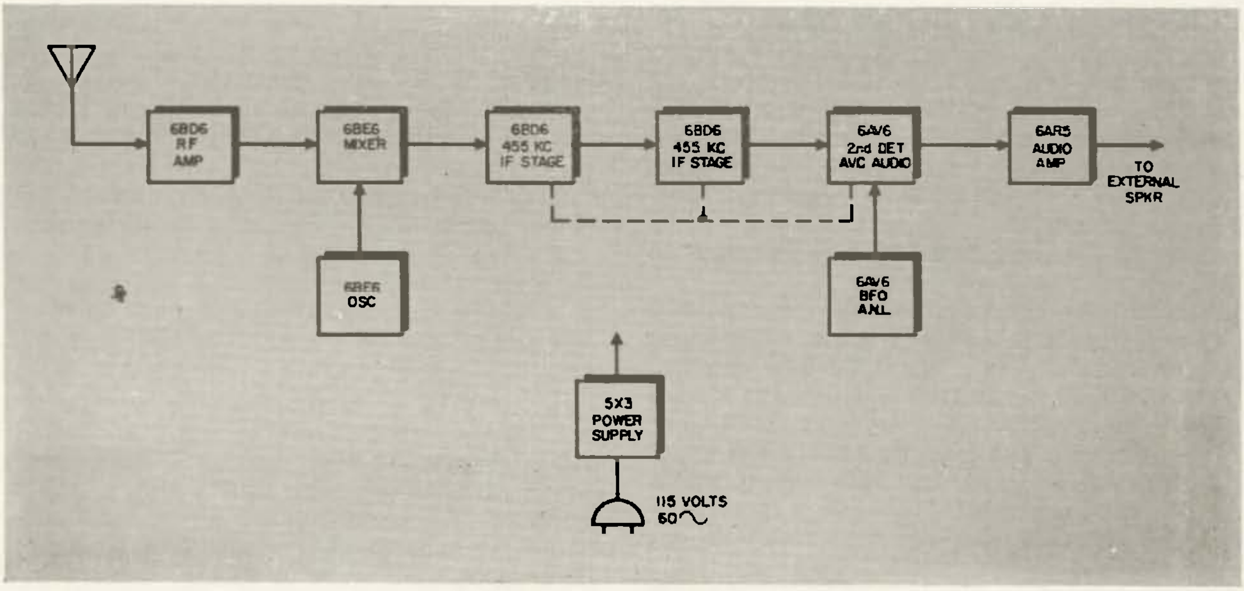


Figure 1. Block diagram of KT-200.

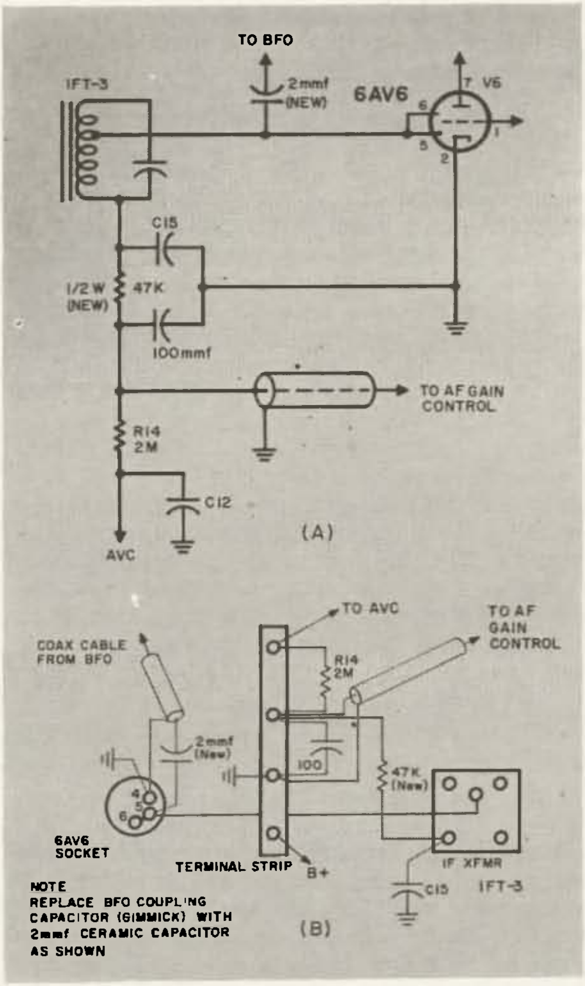


Figure 3. Revised avc circuit and parts layout, bottom view. Note: replace bfo coupling capacitor (gimmik) with 2 mmfd ceramic capacitor as shown.

making it really useable as a ham-type communications receiver. As is, the receiver seems to be fairly insensitive on 10 meters, has a tendency towards self-oscillation at the low end of the broadcast band (550 kc), and has a bad a.v.c. "pumping action" that produces an annoying frequency shift on 10 meters that varies with the strength of the incoming signal. Fortunately, these defects can be easily eliminated with a few hours work, and the modified receiver does an admirable job on all frequencies, considering its modest price. It compares favorably with other receivers falling in the $150 price class as far as results go, and results are what count!

Increasing Gain and Sensitivity

The use of a 6BD6 tube in the rf stage does little to enhance receiver performance. This little "bottle" is the midget equivalent of the metal 6SK7, which in itself is no "barn burner." Substituting a 6BA6 (same pin connections) for the 6BD6 (V1) will go a long way towards acceptable 10 meter performance. To make this change, it is necessary to reduce the cathode resistor (R2) from 300 ohms to 68 ohms, and to change the S-meter series resistor (R4) from 1500 ohms to 600 ohms. These changes are shown in Fig. 2. While you are doing this chore, you should also change the cathode resistor (R8) of the 6BE6 mixer stage from 300 ohms to 80 ohms. Finally, change the cathode resistor (R13) of the last 6BD6 *if* amplifier from 1000 ohms to 330 ohms. This will boost the overall gain of the receiver by a significant amount. Loosen the bolts of the mixer (V2, 6BE6) socket and slip a socket shield base and shield over the socket.

The next step is to stabilize the receiver so that it is less prone to self-oscillation. Looking at your schematic that accompanies the receiver, you'll note that there is no screen

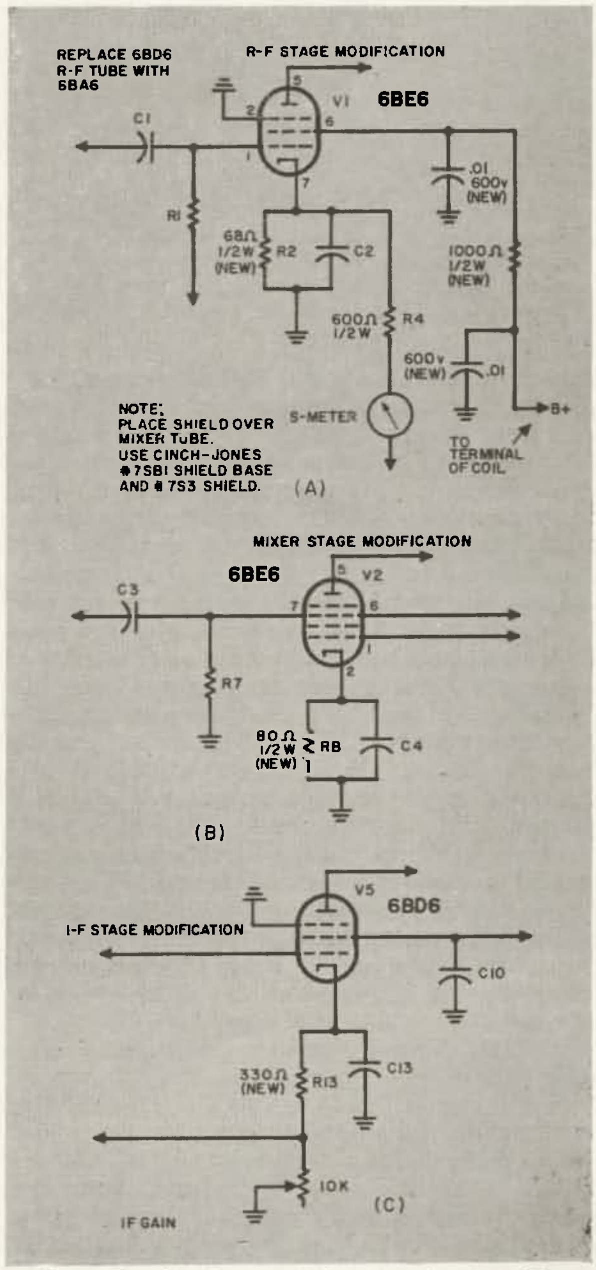


Figure 2. Circuit modifications for the KT-200 receiver.

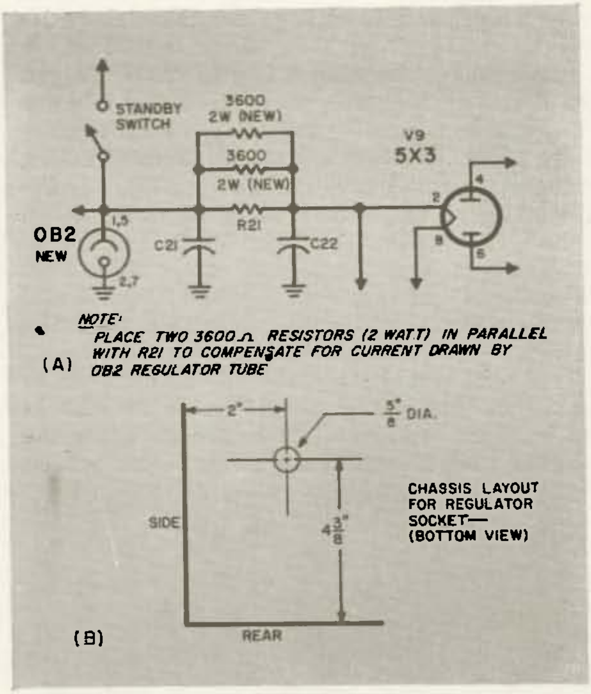


Figure 4. (a) Note: place two 3600 ohm 2 watt resistors in parallel with R21 to compensate for current drain by OB2 regulator tube. (b) Chassis layout for regulator socket, bottom view.

bypass capacitor on the 6BA6 rf stage socket (pin #6). Actually, there is one, but it is one of the power supply filter capacitors at the opposite end of the receiver that serves a double purpose. This is a bad state of affairs, to say the least, and the designer responsible for this fiasco should have his wrist slapped with a steel ruler. Examining the receiver, you will notice that a wire runs from pin #6 of the rf tube socket to a terminal of the center coil compartment. This is the screen voltage lead and should be removed and replaced with a 1000 ohm, ½-watt resistor. The resistor serves to isolate the screen circuit from the rest of the receiver wiring. A .01 ufd, 600 volt disc ceramic capacitor is soldered between pin #6 (screen) and pin #2 (ground) of the rf tube socket, and a second similar capacitor is placed between the opposite end of the resistor (which terminates in the coil compartment) and an adjacent ground soldering lug. The circuit changes are shown in Fig. 2. Replace the 6BD6 with a 6BA6.

The last step is to provide additional *if* signal filtering on the a.v.c. line. This change is shown in Fig. 3. As is, a small amount of the *if* output voltage is fed into the a.v.c. line and thus back into the front end of the receiver. When the receiver is tuned near the intermediate frequency (the 550 kc region) a marked instability can be noted. Additional circuit isolation is obtained by the addition of a 47,000 ohm, ½-watt decoupling resistor and a 100 mmfd bypass capacitor to the a.v.c. circuit. Placement of these new parts is shown in the illustration. Simple!

Stabilizing the Oscillator

As the a.v.c. action takes place, the bias fluctuates on the rf and *if* stages, causing the plate current of these tubes to vary. The simple resistance-capacitance power supply filter produces a corresponding voltage change which wreaks havoc with the high frequency oscillator section of the 6BE6 mixer tube. An OB2 regulator tube, installed as shown in Fig. 4 will cure this annoying fault. A small hole for the tube socket is punched in the chassis as shown, and two holes are drilled to accommodate the socket mounting bolts. Easy now, you don't want to get metal filings into the variable tuning capacitor! Wire the socket and shunt the 2000 ohm voltage dropping resistor in the power supply to compensate for the added current drawn by the regulator tube. You will know the tube is operating properly when you observe the purple glow between the electrodes. This glow will change in intensity as the *if* gain control is varied, which is normal.

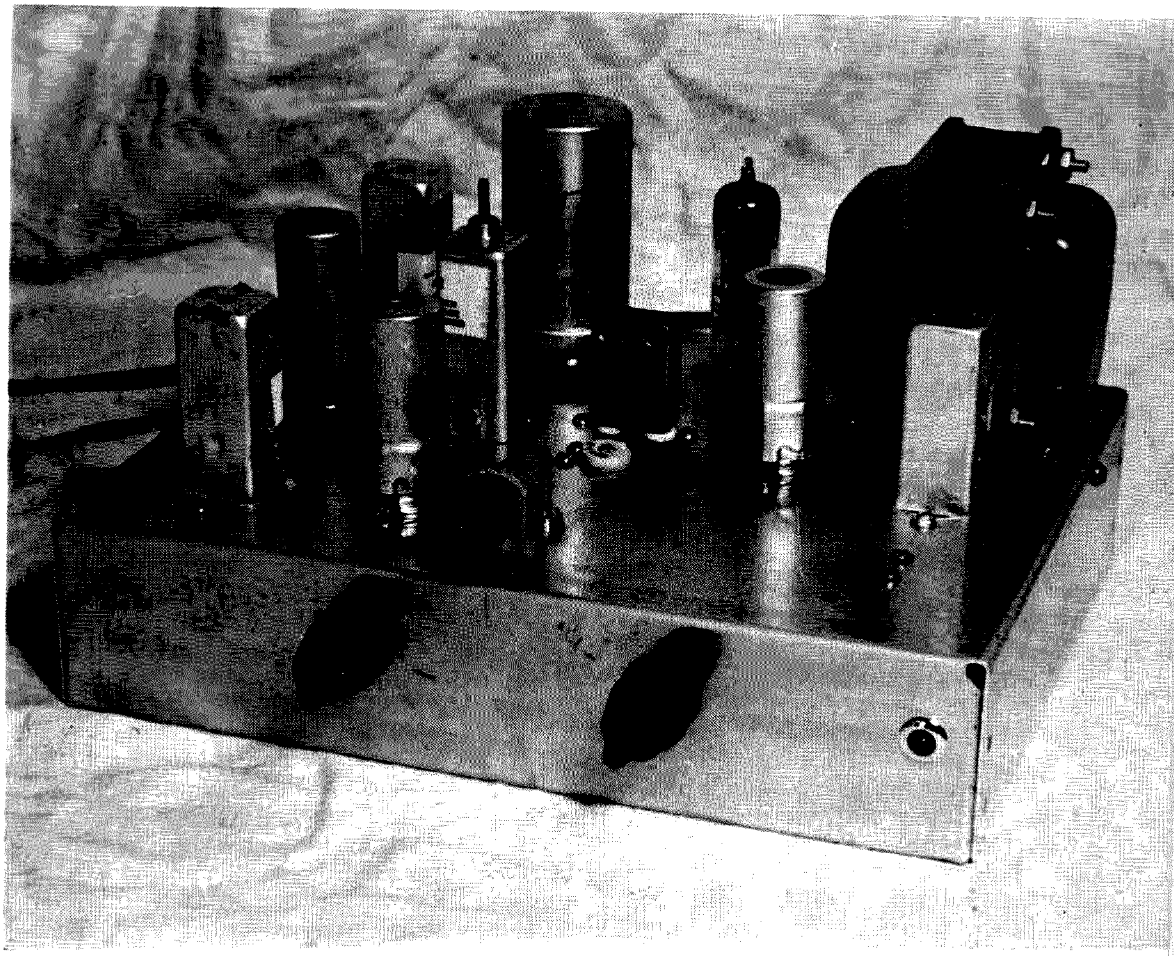
Additional Hints

Does the tuning of this (or any other receiver) seem a bit jumpy at 10 meters? If so, place a wee drop or two of TV "turret cleaner" liquid on the bearings of the two variable tuning capacitors. Also, minute changes in tension of the rotor bearings located at the rear of the capacitor gang may work wonders. If the bearing is too tight, the rotor tends to turn in little increments, or jumps, producing a nervous, erratic tuning effect. Too loose, the bearing produces a sloppy effect that varies when the receiver is subjected to vibration. . . . W6SAI

High Voltage Insulation For Meters

Often the home constructor will go to some trouble to submount a meter because of the high voltage danger. One cause of this danger is the zero-adjustment screw which is sometimes connected to the meter circuit. This is generally a slotted rivet arrangement with an off-center projection. This projection is arranged to shift the anchor point of one of the centering springs. If the meter is disassembled, it is possible to put a piece of spaghetti on the projection and insulate it from the circuit. Then, if the insulation from the movement to the case is sufficient for the voltage to be used, the meter may be mounted normally with no danger. When it can be used, this method will save a lot of trouble.

. . . KøWML



A New Panadapter Unit

J. H. Ellison, W6AOI and R. L. Hopton, W6LQK

THE principle of panoramic reception is not a new development either in theory or in the reduction to actual hardware. It has never received wide acceptance and general use by the Amateur which is probably due to two reasons, one, a limited appreciation of its utility and, two, the cost of the equipment. We propose to point out not only the obvious uses but also some of the less obvious but extremely useful ones, and also how you can build at a nominal cost, your own panadapter, which is at least equivalent in performance to any conventional commercial model. At the outset you may rest assured that it is considerably more than just an interesting piece of gadgetry,—it can be a very valuable adjunct to any amateur station.

Let us review what a panoramic receiver does for us before we discuss how easily we can achieve this capability. In a nutshell, the panoramic receiver presents on a scope screen, all the signals present in a wide band of frequencies at any one time. The center frequency of this band is the frequency to which the aural receiver is tuned. The aural receiver is the usual station receiver, operated in the usual manner, and listening to as *few* stations at once as the receiver is capable of, or as the QRM will allow! The panoramic receiver permits us to *look at* the band approxi-

mately 50 kc both sides of the listening frequency. Now, what use is this to us that might make us interested in having a panoramic receiver? Just what do we see?

All the signals within the bandpass appear as parallel spikes, spaced according to the amount they are removed from the center frequency and each other. Each type of signal has its own readily recognizable characteristic, AM, FM, SSB, RTTY, CW, Auto ignition, pulse noise, random static, etc. Fading, drifting, image signals, false signals from receiver oscillator harmonics, modulation, keying and other phenomena are readily apparent. The distribution of stations within the passband and their comparative strengths are continuously shown. Now, how do we use this information?

The presentation can be used for the following purposes:

(a) Examining propagation conditions on the band in question, for example, activity, fading, noise, static, etc.

(b) Detection of sporadic openings on dead bands without continuously combing the band with the tuning dial.

(c) Estimating percent modulation and over-modulation on AM signals, frequency modulation on AM signals and amplitude modulation on FM signals.

(d) Finding open channels for calling or QSY'ing.

(e) Spotting stations calling off the listening frequency. This is particularly useful when working foreign bands since stations suddenly appearing at the end of your call may be answering you and you can jump rapidly from one to another to check the call, knowing there are no responses in between.

(f) Spotting strong interfering stations or splatterers (without actually tuning on them) so that it is possible to move away from them for listening or calling.

(g) Identifying false signals from receiver oscillator harmonics which will move across the scope at twice the speed of other signals.

(h) Identifying image frequency signals which will move across the scope in the opposite direction from other signals.

(i) Checking keying characteristics of CW signals where the presence of spikes on leading or trailing edges of the keyed signal, indicates transients which produce key clicks, thumps and chirpy signals. You can check your own transmitter performance for many of these characteristics without having to rely on someone else's estimate or well-intentioned but frequently misleading comment.

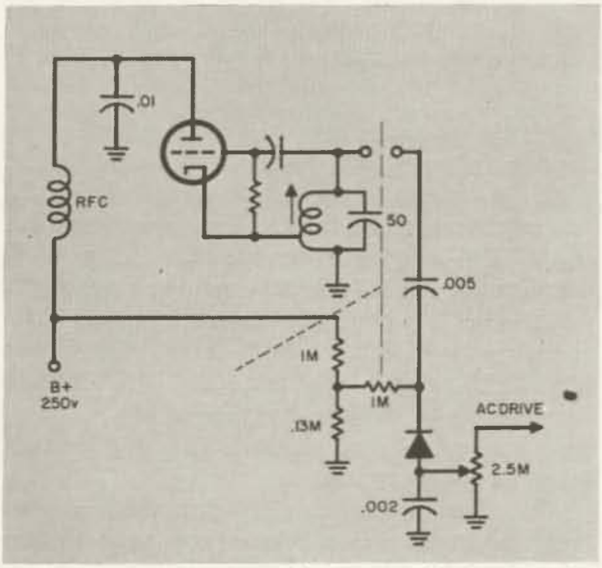
Now we get to an important part of this discussion, namely, what equipment do we need for panoramic reception? It is possible to enjoy the advantages of panoramic reception with the below listed equipment; the regular station receiver with one take-off connection made to it, the adapter to be described and a scope, either integral with the adapter or separate. No other gear will be "snuck in" obscurely, later in the discussion, as an essential part of the system. Moreover, the performance and utility of the receiver is not impaired in any degree.

The panoramic adapter consists of a broad band input stage which takes the signals from the aural receiver's mixer stage at the *if* frequency, heterodynes them to some other frequency, passes the signals through a highly selective system, demodulates them and puts them into the scope vertical system. In order to get the wide band presentation, the oscillator section of the panadapter mixer is frequency-swept over a wide band, heterodyning in succession each signal that comes through the broad band input stage and racking up on the scope face all the signals like a picket fence. The major stumbling block in the past to a simple panadapter unit has been the complication of getting the sweep frequency by either a mechanical system or a multi-tube reactance modulator. It is now possible to get wide frequency sweep with nothing more than a small diode and some resistors. The diode in question is a silicon diode which exhibits a varying capacity depending on the voltages which are impressed on it. These voltages are small and the current requirements are on the order of a microampere. As typical of these diodes we can look at those produced by *Hughes Aircraft* which are .265 inches long and .1 inches in diameter. When used as voltage-sensitive capacitors, the voltages are applied to the diode in the direction opposite to normal diode conduction. This is spoken of as "back-bias." Considering as a specific example the *Hughes* HC 7001 we find that with a back-bias of .1 volts the diode is in effect a 90 mmfd condenser. As we increase the bias (so that the positive voltage on the cathode exceeds that on the anode) from plus 0.1 volts dc to plus 100 volts dc, the capacity changes from the original 90 mmfd to about 7 mmfd. (The capacity is proportional to the —.46 power of the voltage.) This means that by applying a varying voltage to this diode we can get a ten to one capacity change, which if this were the only capacity in the circuit would give a little more than a three to one frequency change. Actually, for our application we won't need anything like this swing, so we can proportion the fixed and variable capacitors and use a small voltage swing to give any amount of frequency swing desired.

Now, if we want to use this silicon capacitor in an oscillator circuit we must pick a basic voltage bias which determines the center frequency of the oscillator and vary the bias voltage at a periodic rate to either side or both sides of the basic bias. As it works out, it appears to be better to vary to both sides for the following reasons; the voltage feed system is simpler, a better capacity range is obtained

and we can avoid running into the conduction range of the diode. This last reason comes about because the mixer oscillator operates with an rf swing on the tank circuit across which the diode is connected, and if the rf swing and the bias swing overlap at any time the diode goes into the conduction range. In a practical oscillator circuit this can easily be checked by measuring the bias voltage on the diode while increasing the bias swing from zero to maximum by means of a variable sweep control. If the basic or resting bias rises at any point indicating conduction, then either change the basic bias or limit the bias swing. In an actual adapter unit such as we use this offers no problem and it is quickly adjusted once and for all, in the original design.

An actual circuit for a frequency modulated oscillator can be derived from any conventional oscillator circuit and for purposes of illustration let us take the familiar Hartley oscillator shown to the left of the dotted line in Fig. 1. The parts shown to the right of



the dotted line are those required for the production of the frequency modulation, and as you see are very simple. The values shown are suitable for a basic frequency of about 2 mc. The inductance can be an ordinary broadcast band loopstick. Before we go any farther in discussing the operation, let us point out that an ordinary *Sarkes-Tarzian* M-500 Silicon rectifier diode is practically identical in voltage-capacity range to the above mentioned *Hughes* HC-7001 and costs less than a third as much. There may be minor variations in diodes but the variations are not significant in the performance of the circuit, since there is plenty of leeway in the circuit adjustment. The voltage divider on the B plus supply establishes the basic bias on the diode cathode through a one megohm decoupling resistor. The .005 and the .002 condensers are simply low impedance dc blocking condensers and are not critical in value. By varying the voltage on the diode anode with an ac voltage, the difference between the fixed bias value and the instantaneous ac value determines the diode capacity, and proportionately, the oscillator frequency. Hence we have an extremely simple, compact, non-mechanical, stable frequency modulated oscillator, with a variable sweep-width feature depending on the value of the ac voltage from the 2.5 megohm potentiometer. Incidentally, we should also mention that the capacity-temperature variation of these diodes is essentially flat over a very wide range. In the circuit shown, a peak ac swing of 10 volts will produce about a 50 kc frequency swing at 2 mc.

There is one minor disadvantage inherent in the silicon capacitor which should be noted here. That is, equal voltage swings plus and minus do not produce equal capacity changes, so that the frequency swing is larger in one direction than in the other.[1] In view of the extreme simplicity and compactness of this frequency-modulated oscillator it is felt that the unequal swings are relatively unimportant.

Referring to Fig. 2, it can be noted that the remaining portions of the adapter are not too unconventional. Some comments are in order, however, to forestall questions. The input stage is a broad band stage centered on the aural receiver's *if* frequency. However, it must be broad banded in such a manner as to give a rising gain characteristic above and below the receiver *if* frequency to compensate for the falling characteristic of the receiver above and below its *if* frequency so that the resultant band of frequencies fed to the pan-adapter mixer is as nearly flat as can be obtained. This is to insure that signals presented on the scope are all in their proper relative amplitudes. Naturally, this alignment is made with the receiver to be used with the adapter because of differences in front-end selectivity among receivers.

In choosing a conversion frequency for the mixer it was essential to pick one suitable for components easily obtainable, hence the mixer output was chosen to be near 1500 kc. This

1. With the unit described as an example, if the sweep range is set to show say 25 kc below the center frequency the region up to about 40 kc above the center frequency will be shown on the other side. If for some special application, it is essential that the swings both sides of the center frequency be equal, they can be made so by a special circuit modification using a different silicon diode and the following procedure. Select a diode having a large capacity at the resting bias, such as the Hughes HC-7004. This has a capacity of approximately 33 mmfd at plus 20 volts bias and gives a change of approximately plus 10 mmfd and minus 5 mmfd for voltage swings of minus 9 volts and plus 9 volts respectively. Make a series arrangement of the diode and a small condenser of about one-half its capacity. This series arrangement will give practically equal capacity changes each side of the resting capacity value for equal voltage swings each side of the resting bias. The inductance and fixed capacity of the oscillator circuit must be adjusted so that the variable capacity range produces the required frequency-swept range.

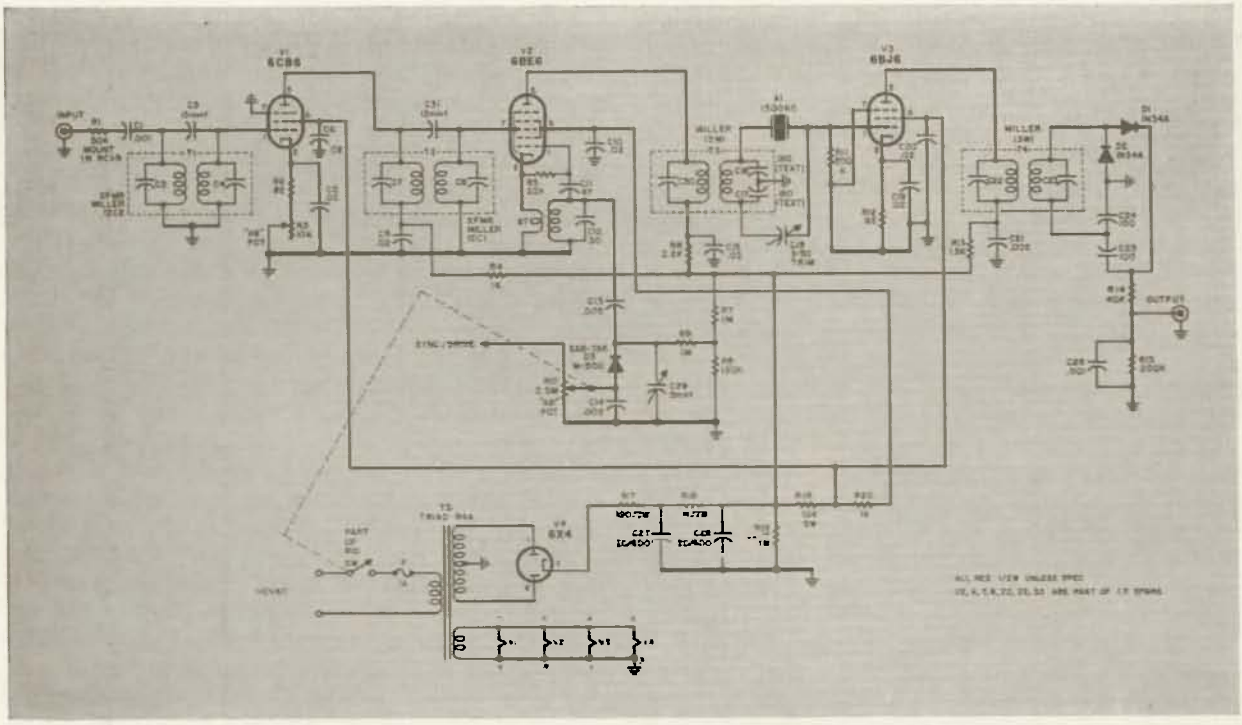


Fig. 2—T6 is a standard ferrite-cored loopstick. You will find this discussed at length in the text.

permitted using available miniature *if* transformers for this frequency, and also permitted using an oscillator frequency high enough to get a wide FM characteristic with a small capacity change in the diode. It also made practical the use of a standard ferrite-cored loop-stick of the broadcast variety as the oscillator inductor in a tickler feed-back circuit. The loop-stick has a wide range of inductance available to compensate for considerable variations in other components. This simplifies tune-up and alignment of the oscillator circuit. The oscillator bias of the mixer, as determined by the negative grid voltage, must be set as low as permissible while still getting good conversion transconductance. This precaution accomplishes two ends, first, it prevents overlapping of oscillator rf swings and diode swings which might bring the diode into the conduction range, and second, it keeps the oscillator harmonic content low and avoids spurious signals in the mixer output.

Using 1500 kc as the conversion frequency with available miniature transformers would not give adequately sharp signal peaks on the scope so we use a 1500 kc crystal to give real spikes for each observable signal as the FM oscillator sweeps the band. This improved resolution is a real joy to behold. The crystal input transformer and bridge balancing condenser are adjusted for best symmetry of signal response. This is easily done while observing the scope pattern. The crystal rejection notches on each side of symmetry are readily distinguished (Just like in the book!). With the over-all gain available, the insertion loss of the crystal is not significant and the crystal filter circuit termination may be a simple high resistance, also acting as the grid return for V3. Note also that the crystal frequency is not critical as long as it is within the tuning range of the nominal 1500 kc transformers and as long as the crystal has no spurious responses within plus or minus 50 kc of its primary frequency.

The detector circuit differs in two respects from the usual. First, it uses a voltage doubler circuit which gives us a "free" gain of two and second, the diodes are arranged to give a positive voltage output so that with the conventional scope, the signal peaks are up from the base line. Several volts output are obtainable although less than two volts are required on the average scope with a vertical amplifier. An integral power supply is provided with a resistance-capacity filter. With the low power requirements the simple filter is more than adequate.

We have purposely avoided the subject of methods of obtaining sweep voltage until now. Since no power is required for sweep purposes we might consider that any constant, repetitive voltage might be suitable, g.e. the tube heater supply voltage, with only the proviso that it can be synchronized. However, there are considerations regarding synchroniz-

ing which we had better cover later after we discuss the scope and its functions. Let us just say in passing that sweep stability just isn't a strong point of simple sweep circuits.

Earlier we said that the scope might be integral with the adapter unit or separate. An integral scope is not recommended for three reasons. First, building a scope with all the usual controls and installing it in the adapter would limit the utility of the scope to this use alone. Second, scopes of various sizes are available in kit form for separate assembly. Third, if you already have a scope this adapter provides another excellent use for it. The functions of a scope suitable for panoramic reception are the usual ones found on all but the simplest of scopes. They are, beam intensity and focus, up and down and transverse beam positioning, vertical and horizontal amplifiers, a variable saw-tooth sweep, sync control and provision for either external or ac line synchronization.

Whatever method is chosen for obtaining the frequency sweep in the oscillator of the adapter, it is obvious that the adapter and scope sweeps must be synchronized. There are refinements of this requirement that are not immediately obvious. They are, first, only the most involved sweep methods have absolute and constant accuracy, second, the scope sweep is customarily synched with and triggered by the vertical amplifier in the scope. However, the signal passing through the vertical amplifier consists of a number of vertical pulses, some large, some small, so how does the sweep know which one to sync on,—or if it syncs on one large signal which then goes off the air it must find another large one. This operation would produce an intolerable jitter of the picture. The only alternative is to sync on some common reference source which is readily available in the ac line.

Now let's make the obvious conclusion that we will simplify the whole business by synchronizing the scope sweep to the ac line and use the scope sweep voltage for *both* the scope *and* the adapter oscillator. This way there is no longer any problem of sync and no necessity of a separate sweep in the adapter. The scope sweep can be picked off the plate of the horizontal amplifier through a .05 mfd ceramic condenser and run to an insulated pin-jack on the front of the scope. This involves no extra wires between the adapter and scope because a sync connection would have been necessary with any method considered. The scope sweep is connected through a shielded cable to the top of a 2.5 megohm potentiometer in the adapter and the desired voltage amplitude for the adapter oscillator is applied to the silicon diode anode. The potentiometer should be about 2 megohms so as not to load down the scope horizontal plates and lose horizontal size of the picture. A slow sweep should be used for good stability,—about 30 per second gives an excellent picture.

The 2.5 megohm potentiometer permits setting the sweep width from zero to well over 50 kc each side of the center frequency. On the lower frequencies about plus or minus 25 kc is a good working range but on the higher frequencies with wider bands the greater sweep is useful. The narrow sweep permits checking signals close to the center frequency and spreading the picture improves the resolution, or the ability to distinguish between signals very close to each other. By reducing the sweep to zero the quality of modulation can be examined in detail for signals on the center frequency. Also at zero sweep the shape of a keyed signal will show up plainly. A string of dots will tell you instantly whether the keying circuit needs shaping filters, to eliminate spikes or transients. The sweep width control may be calibrated since it remains a constant width in kc regardless of the band to which the primary aural receiver is tuned.

A small variable padding condenser (about 5 mmfd) is provided as a control for band center. This may be calibrated in conjunction with the sweep width control as there is a slight shift of the band center on the scope with different sweep widths. This is due to the non-linear capacity-voltage characteristic of the diode and is not important unless it is desired to read the frequency of a signal in terms of "kc removed from center frequency." It is suggested that the sweep width control be calibrated at the 40 kc, 20 kc, 5 kc, and zero points. In fact, if desired, the potentiometer values at these points could be measured and fixed resistors and a switch substituted.

The connection to the companion receiver is made to the plate circuit of the mixer stage by connecting one end of a 50,000 ohm half watt resistor to the lead between the mixer plate and the first *if* transformer primary and bringing the other end of the resistor out through a small coax or shielded cable to the input of the adapter unit. The cable should be as short as convenient,—30 inches will be more than enough in most cases. The presence of this attachment will have no effect on the signals through the receiver whether connected to the adapter or not, since the 50K resistor is sufficient isolation for the cable termination. However, don't let the end flop around and ground because it has both rf and dc on it and can be awfully noisy! The output of the adapter goes to the scope vertical amplifier and should be shielded against stray noise or ac pick-up. There are three control levels which set the picture size, namely, the receiver rf gain, the adapter gain and the scope vertical amplifier gain. Usually, the receiver gain is set first for signal level and the adapter gain set just below the level which produces "grass" on the picture base line. The scope amplifier is then set for size.

In summary, what we now have is a fixed-tuned adapter with three controls,—gain, sweep width and band center shifter. In normal use, the scope and adapter are set only once at proper levels of sweep and gain and these remain the same regardless of the frequency band on which the receiver is operating. No adjustment or trimming is required, —if you can hear them you can see them. The basic theory and design methods have all been set forth if you want to take-off and solo but you are strictly on your own. Next month's article will show an actual unit as built and currently in use. Typical patterns with their interpretation will be shown and a dimensioned chassis layout and a list of readily available standard components will be provided. With the chassis layout, photographs and schematic the construction of a similar unit will be as easy as assembling any standard kit. The alignment and adjustment described is straightforward and un-complicated when carried out in the proper sequence and requires no periodic readjustment. Since the connection to the companion receiver requires no permanent alteration and leaves the operation of the receiver unaffected in any respect either with the adapter on or off, the panoramic feature can be used at will. Of course, the visual presentation is the same whether the receiver is being used for SSB, AM or CW reception. Your scope is also still available for other uses simply by disconnecting two wires or cables. Once you have gotten accustomed to using the panadapter we doubt you will ever turn it off.

Now while you are waiting for the rest of the story you may want to explore other possibilities of the silicon capacitor. The system described is applicable to small frequency changes as well as large. For example, for VFO use or FSK in teletype, the silicon capacitor can be connected across one or two turns of an inductor and a desired frequency shift obtained by dc voltages. Note that since extremely minute currents are drawn by the diode it can and should be decoupled from the voltage sources by high value resistances. This means that remote control leads can be any convenient length.

(Concluded next month)

Automatic Drive Control (ADC)

Vernon L. Trexler, W5IUR
2459-A 45th
Los Alamos, N.M.

When you exceed the drive to a class AB_1 amplifier tube, grid current starts to flow. If you automatically cut down the drive when a few microamps of grid current flow, you have Automatic Drive Control. ADC requires a circuit that has no output with no grid current flow, and puts out a negative voltage that is in direct proportion to the amount of overdrive. This requires a dc amplifier, which in addition to tubes, usually requires some odd voltage power supplies.

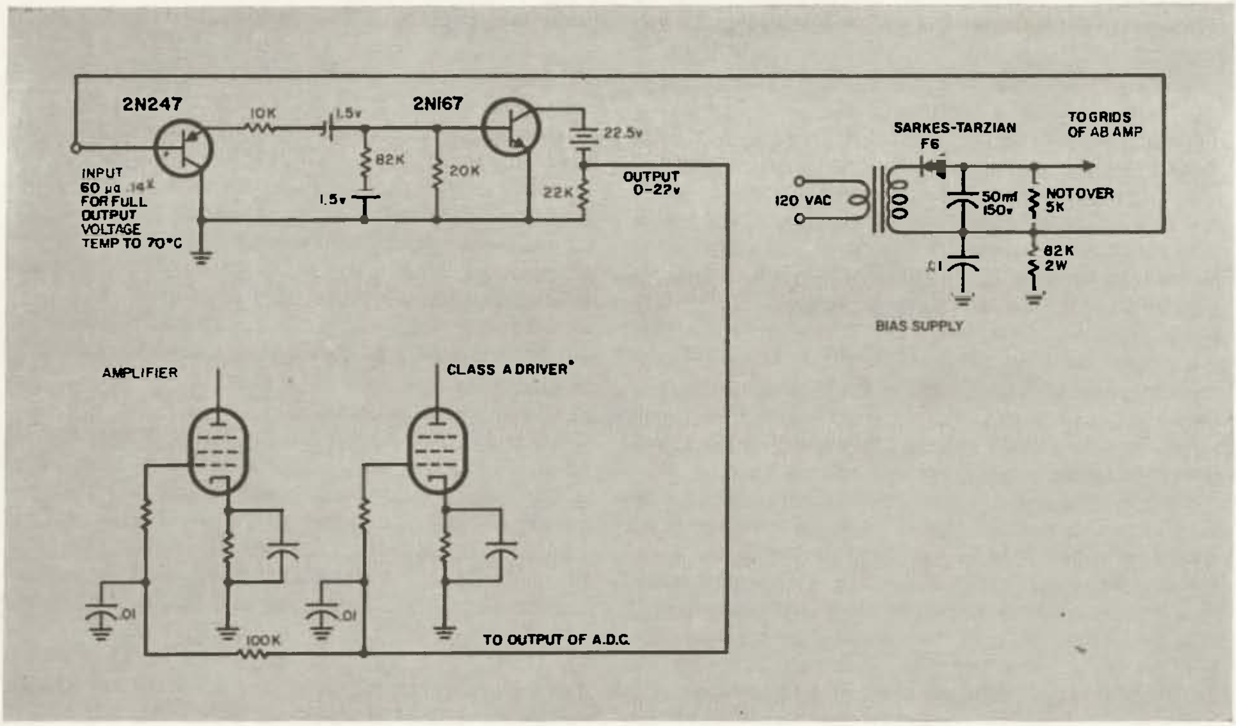
Transistors seem to be a better answer. A circuit has been worked out that is quite satisfactory. One of the problems that presented itself was the heat that might be encountered in a transmitter, so heat was applied to the developed circuit and the circuit was modified until it could withstand a temperature of 70°C (150°F). This is pretty warm. To be on the safe side the circuit should be located in a "cool" place in the transmitter, not near any large tubes or power resistors.

The circuit is a simple PNP and NPN dc amplifier; however, since there is no dc output with no ac input, and the heat problem, the transistors that are shown should be used. The first transistor does not have protective bias, so there is no output with no input. Small AA or AAA flashlight batteries are used for the 1.5 v., and a hearing aid battery for the 22.5 v. supply.

Here is a general idea of how to "hook" it into your circuit. First, let's take a took at your bias supply for your class AB_1 amplifier. The lower the resistance of this supply the better will be your ADC. If a battery or electronic bias supply is used, all the better. If a regular negative supply is used, the smaller the resistor across the bias supply without exceeding the current rating of the bias transformer, the better your ADC 5000 ohms will be about the maximum.

This bias supply must not be tied directly to ground, but must be isolated from ground by an 82K2 watt resistor. The diagram also shows where you can connect the input of the transistor amplifier. The resistance in the series with the bias supply will not be detrimental unless you change from Class AB_1 operation.

Most AB_1 amplifiers can have at least 100K resistance in the bias supply. If you exceed the drive requirements there will be distortion added to your signal. When a few microamps of grid current flow, the distortion is still very small. 10 microamps of grid current develop a voltage of 0.82 volts across the 82K resistor, when this is applied to the input of the transistor amplifier there is an output of approximately —16 volts. This voltage is fed to the



grid of a previous driver tube or tubes to cut the gain down. The tubes you select will determine how the circuit operates and how much grid current flows; remote cutoff type tubes are nice, but not an absolute necessity. If you don't have enough cutoff with one tube, try two or more.

With the proper choice of tubes for the feedback, the transistor amplifier will probably not be required to put out over eight volts, showing a final grid current flow of approximately 6μa. This could be reduced with more tubes being controlled, but proved satisfactory for me.

You should not use ADC as a means of turning all the gain control full on (although it will limit the drive and work satisfactory). The ADC should be used to keep you from "spilling" over on peaks.

. . . W5IUR

Dear Sir:

Allie C. Peed, Jr. K2DHA
34 Ashley Drive
Rochester 20, N. Y.

THERE comes a day in the life of each of us when we have a complaint, question, or sometimes, a bouquet or constructive suggestion to toss in some equipment manufacturer's direction. A little knowledge of how this can best be done will offer great dividends in the effectiveness and promptness of the interchange of communications.

One cardinal principle should be kept in mind from the outset in this matter. In spite of the fact that you are addressing your letter to a cold, formal, impersonal corporation, don't lose sight of the thought that the one who reads and acts on your letter is going to be a human being. He is subject to the same reactions, emotions, and limitations as you. He is not clairvoyant, so you have to tell him exactly what you have in mind together with necessary background detail to enable him to understand your problem. You are probably too close to the problem to allow you to observe strict objectivity unless you exert special effort.

Give all the details. Even if they don't seem too important or pertinent to you. Describe your equipment exactly; model, serial number, etc. Then tell how you are using it. Exactly what's the problem? What are the symptoms of the trouble? What performance are you expecting and not obtaining? (It just could be that you are expecting more than the equipment was designed to do.) What auxiliary equipment is being used? Has your unit been modified in any way? Etc., etc.

Don't start off with a chip on your shoulder! Try to give a dispassionate objective presentation of your problem. Give the company half a chance to help you before you start calling names. They may be fully aware of a solution to your problem and eager to help you set it right. A straightforward presentation of your case will put the manufacturer's correspondent in a more sympathetic mood than a heated

denouncement of the gear and the company in general.

Don't try to hide or hold back any pertinent information. Don't represent the equipment as having just been purchased when in fact you've had it for a year or so. The manufacturer may have an exact record of when your gear was purchased and can peg you as a prevaricator before you get off the ground. If you have had some sort of accident resulting in damage to the gear at some time in the past, describe this and any local repairs that you may have made. Remember that if you end up by having to send it to the manufacturer's repair service, they will see the damaged or replaced parts anyway, and more correspondence may be necessary then.

Don't ramble in your letter. Be specific and to the point within the bounds of giving complete information. It is best to confine your letter to one general subject only. Just because you "have a letter going that way anyhow," don't throw in all the other questions that you've been wanting to ask for sometime. Different types of inquiries are answered by different people in many firms. Thus, a letter containing a multiplicity of queries will take longer to answer since it must be passed along from department to department before all of the answers are obtained.

Be sure to give your name and full address, either typed or in block letters, *on your letter itself*. Don't depend on the return address on the envelope and your scrawled signature. Many firms open their mail in a mail room where the envelopes are discarded while the letters are read and routed internally to the responsible parties. You'd be surprised at the number of letters which go unanswered in many large concerns not because of unwillingness or inability on the firm's part, but simply because there is no address to which the reply can be sent.

By all means, read the instruction manual supplied with the equipment *first*. The answer to your question might be contained in the manual. You will look pretty silly asking something which is already detailed in the manual.

Don't write an indignant follow up letter a few days after your inquiry just because you haven't received an answer as promptly as you think you should. The company undoubtedly doesn't have a man sitting at his desk just waiting to answer your letter by return mail. A big firm will receive hundreds and even thousands of letters a day. These have to be opened, read, and routed internally before the correspondent even sees them. The correspondent may have a back log of other letters received prior to yours. Your question may require considerable research and checks with the project engineer, the service department, the parts department, etc. And finally, dictation and transcription may take a day or so. This whole process takes time, so show your appreciation for the service you expect by having a little patience. Incidentally, in subsequent correspondence, if you address your letter to the original correspondent, don't be surprised if the reply takes even longer. Letters addressed to individuals are usually delivered unopened to the addressee who may be out of the office on a business trip or vacation. Hence, your letter may not be opened for a week or more. It is better to address your letter to the company and then to the attention of the individual if you wish. Letters so addressed are usually opened and referred to another correspondent assigned to cover for one who may be absent.

If you don't receive a reply in a reasonable length of time, don't "fly off the handle" and start calling people names. Write a polite inquiry giving the date and general subject of your previous letter. This will enable the company to attempt to trace your first letter. It might be that they couldn't make out your name or address on your first letter. It might be that your first letter or the reply went astray someplace. It might be that an honest error in office routine resulted in the letter going unanswered. It might be that they are still holding your letter awaiting engineering data. Give the firm a chance to straighten these matters out.

If you still don't get a reply in say, two or three weeks more time, then you'll have reason to begin to sound off. There are several courses open to you if you feel that a firm is purposely dodging its responsibility in providing service information. You can complain to the dealer who sold you the equipment. You can write the president or general manager of the company. And most effective of all, you can complain to the editor or advertising manager of magazines in which the company advertises. Magazines are very sensitive, for moral as well as legal reasons, about advertisers who don't perform up to ethical standards.

Finally, be reasonable in your questions. Don't expect or attempt to establish a penpal relationship with your correspondent. He probably has enough letters to answer anyhow, and he won't look kindly upon the additional load of "regulars" with trivial questions. You'll wear out your welcome rather soon if you try this. Most manufacturers are happy to provide service information so long as it relates to the proper use of their equipment, but they are not in business to provide you with a running consulting service on all of your electronic problems.

One additional point. Re-read your letter before you mail it. It is well to leave it overnight, or for a few hours at least, and then read it again. If it still makes sense it is probably all right. Hastily written letters often contain inconsistencies or omissions which are easily caught by re-reading with a fresh mind.

DEPARTMENT OF COMMERCE
RADIO DIVISION

REVISED U. S. AMATEUR REGULATIONS

Superseding those dated March 6, 1928

An amateur station is a station operated by a person interested in radio technique solely with a personal aim and without pecuniary interest. Amateur licenses will not be issued to stations of other classes.

Amateur radio stations are authorized for communication only with similarly licensed stations, except as indicated below, and on wave lengths or frequencies within the following bands:

Kilocycles	Meters	Kilocycles	Meters
401,000 to 400,000	0.7477 to 0.7496	8,000 to 7,000	37.5 to 42.8
64,000 to 56,000	4.69 to 5.35	4,000 to 3,500	75.0 to 85.7
30,000 to 28,000	9.99 to 10.71	2,000 to 1,500	150.0 to 200.0
16,000 to 14,000	18.70 to 21.40		

and at all times unless interference is caused with other radio services, in which event a silent period must be observed between the hours of 8 p. m. and 10.30 p. m., local time, and on Sundays during local church services.

Amateur radio telephone operation will be permitted only in the following bands:

Kilocycles	Meters
64,000 to 56,000	4.69 to 5.35
3,550 to 3,500	84.50 to 85.70
2,000 to 1,715	150.00 to 175.00

Amateur television and operation of picture transmission apparatus will be permitted only in the following bands:

Kilocycles	Meters
60,000 to 56,000	5.00 to 5.35
2,000 to 1,715	150.00 to 175.00

Spark transmitters will not be authorized for amateur use.

Amateur stations must use circuits loosely coupled to the radiating system or devices that will produce equivalent effects to minimize key impacts, harmonics, and plate supply modulations. Conductive coupling, even though loose, will not be permitted, but this restriction shall not apply against the employment of transmission line feeder systems to Hertzian antennae.

Amateur stations are not permitted to communicate with commercial or Government stations unless authorized by the licensing authority except in an emergency or for testing purposes. This restriction does not apply to communication with small pleasure craft such as yachts and motor boats holding limited commercial station licenses which may have difficulty in establishing communication with commercial or Government stations.

Amateur stations are not authorized to broadcast news, music, lectures, sermons, or any form of entertainment, or to conduct any form of commercial correspondence.

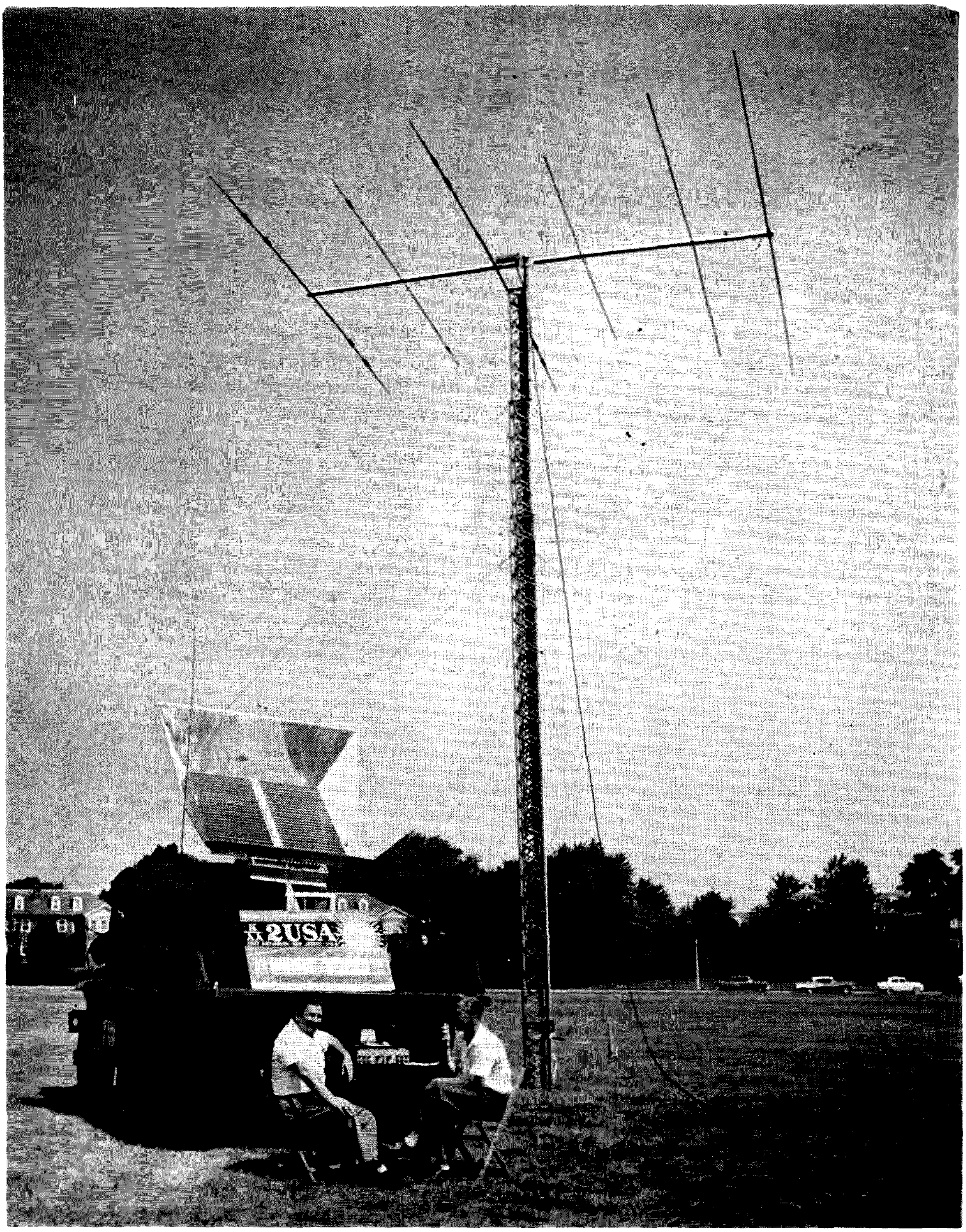
No person shall operate an amateur station except under and in accordance with an operator's license issued to him by the Secretary of Commerce.

SEPTEMBER 1, 1928.

W. D. TERRELL,
Chief, Radio Division.

U. S. GOVERNMENT PRINTING OFFICE: 1928 11—9642

Submitted by Wells Chapin W8ONL, ex-W2DUD, W1DUD, WøDUD, W9DUD, NU9DUD, 9DUD, 9EGQ, 9AZS.



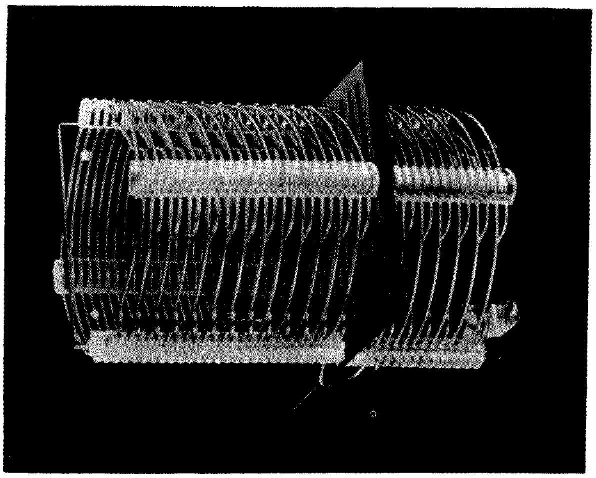
New Field-Day Power Source

Though this demonstration was made primarily for the publicity involved, it still brings home to us some hints on things to come. K2USA set up shop out in a field down at Fort Monmouth, New Jersey and worked quite a few countries on 20 meter sideband. The rig consisted of the little Hallicrafters transceiver feeding a Telrex TM-30 Tri-Band beam and powered entirely by solar cells. There are 7800 cells in the power unit and they provide 250 watts at 12 volts for this demonstration.

New Product

Printed Circuit Faraday Shield

The little comb-like printed circuit slipped between these two Air Dux coils allows highly efficient electro-magnetic transfer between the coils, while nullifying electro-static coupling. I. e., Faraday shielding, with coil Q's as high as 500. Now available for any special series or standard Air Dux coils. While you're writing to tell them you saw it in 73, you might ask for the sheet of design specs on their complete line of high-Q air wound coils for amateur use. The post card you are now whipping out of your post card locker should be addressed to Illumitronic Engineering Corp., 680 E. Taylor Street, Sunnyvale, Calif.



AIR FORCE MARS TECHNICAL NET

Sundays 2-4 pm edst **3295-7540-15715 kc**

June 4—Transistor Reliability.

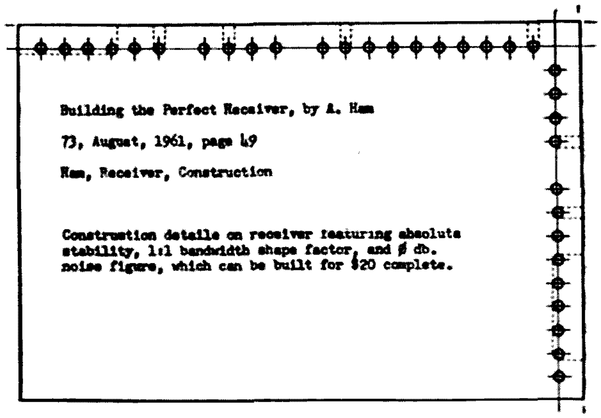
June 11—Advancements in Broad Band Communications.

June 18—Space Tracking.

The Eastern Technical Net will recess until September 17th. Suggestions are requested from listeners as to next season's programming.

Jim Kyle K5JKX/6

How to Build Your Own IBM* Machine



*Identification of Back-issue Magazine-articles

Do you need an IBM machine to keep track of your collection of radio magazines and to enable you to locate that circuit you remember seeing last year but can't recall just where?

You do? Why don't you build yourself one?

Before flinging this copy of 73 out the window, read on a bit. We don't intend that suggestion as an insult or a sarcastic remark! The device described in these paragraphs is almost identical to the forerunner of the present office equipment—with the advantage that it's so simple anyone can build it on the kitchen table in one evening at almost no outlay in parts or materials.

Surprisingly enough, this gadget isn't electronic in any sense—it's purely mechanical. However, its basic principle of operation is the same as that used in electronic accounting machinery, so it can be useful in getting an idea of what goes on inside these machines as well as in solving your home-scale data-processing problems.

Materials you'll need to build the "73 Selector" are simple: a goodly stock of 4 x 6 filing cards. The tools are equally simple: a ticket punch and a razor blade (or scissors). To operate it after it's finished, you'll need a thin knitting needle or a length of No. 12 busbar smoothed off at each end.

Ready? Let's proceed.

First, take a look at the drawing which shows a blank card's hole layout. At this point, ignore the typing on the card and the dotted lines at some of the holes. The important thing is that 33 holes are punched on two edges of the card; they're shown as being on ¼-inch centers with ½ inch between blocks, and located ⅜ inch in from the edge, but exact placement on the card isn't important. What *is* important is that the holes on each of your cards must align to within about 1/64 inch.

If possible, use some type of power punch to go through 100 or so cards at a time. This will assure perfect alignment. However, in the kitchen-table version, you *can* do it all by

(Go to page 46)

Top-Edge Coding (holes numbered from left to right)

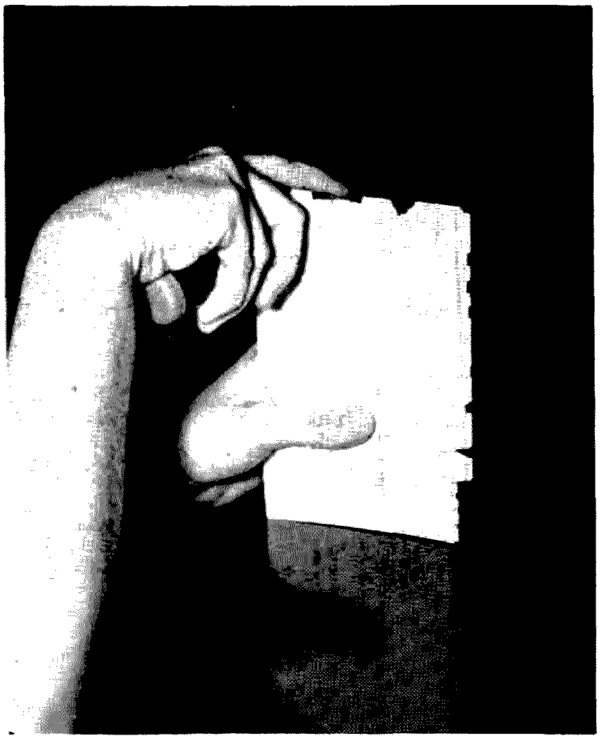
1 2 3 4 5 6	7 8 9 10	11 12 13 14 15 16 17 18 19 20		
—Year—	—Month—	—Author's Last Initials—		
1950: 110010	Jan. 0001	A00001	J01010	R10011
1951: 110011	Feb. 0010	B00010	K01011	S10100
1952: 110100	Mar. 0011	C00011	L01100	T10101
1953: 110101	Apr. 0100	D00100	M01101	U10110
1954: 110110	May 0101	E00101	Mc01110	V10111
1955: 110111	June 0110	F00110	N01111	W11000
1956: 111000	July 0111	G00111	O10000	X11001
1957: 111001	Aug. 1000	H01000	P10001	Y11010
1958: 111010	Sept. 1001	I01001	Qu10010	Z11011
1959: 111011	Oct. 1010			
1960: 111100	Nov. 1011			
1961: 111101	Dec. 1100			
1962: 111110				
1963: 111111				

Right-Edge Coding (holes numbered from top to bottom)

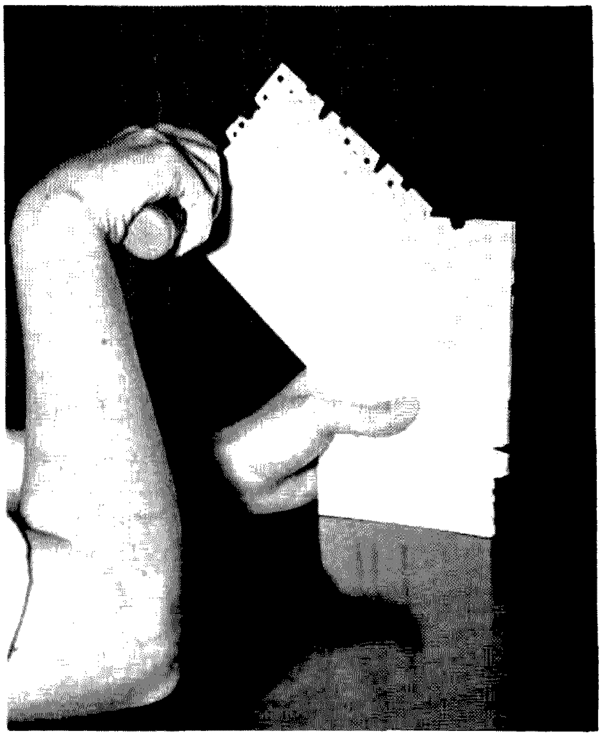
1 2 3 4	5 6	7 8 9 10 11	12	13	Meaning
0 0 0 1					73
0 0 1 0					QST
0 1 0 0					CQ
1 0 0 0					Electronics Wd
0 0 1 1					Radio-Electronics
other combinations holes 1 thru 4					As desired
	0 1				ham radio
	1 0				hi-fi
	1 1				other
		0 1 1 1 1			Ham—Rcvrs Hifi—Amplifiers Misc—A thru E
		1 0 1 1 1			Ham—xmtrs Hifi—preamps Misc—F thru J
		1 1 0 1 1			Ham—Antennas Hifi—Turntable Misc—K thru O
		1 1 1 0 1			Ham—Test Gear Hifi—spkrs Misc—P thru U
		1 1 1 1 0			Ham—Misc. Hifi—Misc. Misc—V thru Z
			0	1	theory
			1	0	construction
			1	1	Product Report
			0	0	Misc.

Note: In top row, holes 11 through 15 are initial letter of author's surname while holes 16 through 20 are second letter of surname.

(From page 44)



Sequence photos showing operation of "73 Selector." An awl is being used in place of the knitting needle, with small deck of cards which is listing for January and February 1961 issues.



hand with the ticket punch. Just mark the location of each hole and be careful when punching.

At this point, you should punch all 33 holes on each card. Remember that you must have one card for each article you intend to list, and that every article in every magazine you have should be listed for the gadget to do you much good.

When you've finished punching the blank cards, proceed to the next step; this consists of going through your stack of magazines and entering the information shown concerning each article, using a separate card for each listing.

The first line of the listing is self-explanatory. The second line lists magazine, issue, and page number. The third line—somewhat cryptically—shows the classification of the article, according to the various categories listed in Table 1. The final entry is simply a brief synopsis of the article, so you can tell later whether it is the one you're trying to find.

After filling in all the cards, you're ready for the final stage of construction. This consists of cutting slots from certain holes of each card to the border, leaving the card as shown in the photo. These slots, literally, are the keys to system success, because they make sorting automatic when you use the gadget.

Before cutting any slots, take a look at Table 1 (which we used earlier simply to get our categories). Note that each category is assigned a number which is made up of the digits 1 and/or ϕ, and also a specific group of holes.

An unaltered hole represents a zero in this code, while a slot is equal to a one. The notation is that called "binary," which is used in almost all computers.

As shown in the table, the row of 20 holes across the top of the card represents the year, month, and author identification of the article. The 13 holes down the side represent the magazine and the classification of the article.

Using table 1 as a guide, cut the holes away into slots as indicated by the classification categories and other indexed information. When you're finished, you'll have a deck of cards with ripply edges, and some will have holes where others have slots and vice versa.

At this point, you can relax. The work is over. All you need to do now is to use the file—and keep it up-to-date by making up new cards every time you get another magazine and adding them to the file.

To pick out all the articles dealing with any one category, simply use the knitting needle to lift the cards. An example will make it easier.

Let's suppose you want all the receiver construction articles which appeared in 73 during 1960.

To start with, use the first four holes from the top on the right-hand side to pick out the 73 cards. You do this by first aligning the cards, then running the needle through hole No. 4 of the entire stack. Turn the stack on its side and lift the needle vertically, joggling the stack at the same time. Some cards will fall away free, since they have slots instead of unbroken holes at No. 4 position. Included in these cards will be those for 73 (code 0001)

as well as those for Radio-Electronics (code 0011) and any other publications whose code ends in 1.

Put the other cards back in the file, and stack those which fell off. Run the needle through hole No. 3 and lift as before. Some will stay on and some will fall off. Since the 73 code is 0001, the desired cards this time are included in those which stay. Put the rest back in the file and repeat this process for Holes Nos. 2 and 1. The result will be that you have all the cards for 73 magazine separated from the rest of the file.

The next limiting category used in the example was the year, 1960. This information is carried in holes 1 to 6 at the top of the card. Using the code as a guide, repeat the stack-thread-lift process to pick out the 1960 cards. The sequence this time would be those cards which lift on hole 6, lift on hole 5, and fall on holes 4, 3, 2, and 1.

You now have remaining all the cards for 73's 1960 issues, which are still not what you were looking for—but what you want is included in them.

Repeat the process still once more, using holes 5 through 13 of the right-hand column, looking for the sequence 010111110. This means ham radio (01) receivers (01111) construction (10).

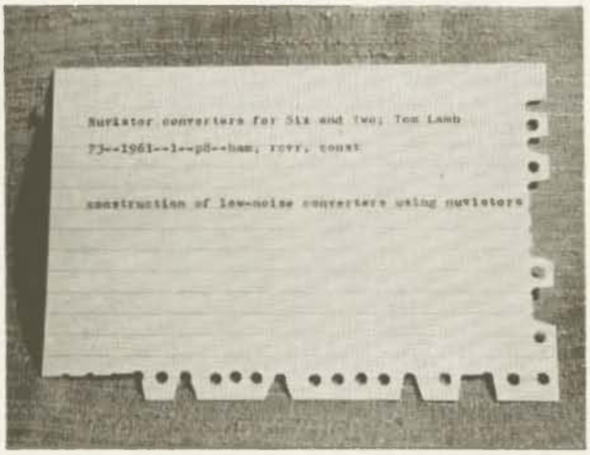
This time round, when you're finished, you

(Turn to page 48)

(Continued from page 47)

have the cards for all receiver construction articles which appeared in 73 in 1960—exactly what you were looking for.

The process sounds a bit tedious when explained in words, but after you've done it once you'll see that the entire thing can be done in less time than it takes to read a couple of sentences explaining how. The pictures show the three steps of a sorting run, using only a small deck of cards.



Card from the prototype "73 Selector." Note that holes shown on top in drawing and in text are on bottom in this set; this was first designed and by experience it was determined that cards would align more easily in file box if holes were on top. Codes for magazines and classifications were also altered slightly; however, any coding will work so long as it is consistent.

Here's how it works, if it hasn't become crystal clear to you yet. As you can see, a card will fall if it has a slot at the particular position used, and will stay on the needle if it has an unbroken hole. Any single hole position can be used for a two-answered question; however, a pair of hole positions can be used to mean four things:

A—code 00, both holes unbroken. The card stays on through both runs.

B—code 01, one hole and one slot. The card stays on the first time but falls away the second.

C—code 10, one slot and one hole. The card falls the first time but stays up the second.

D—code 11, both slots. The card falls away both times.

By assigning specific meanings to each code, you can recover that information from a scrambled deck by picking the order of the sort and the holes. For instance, to locate code 11, you would start with either hole, and after each sort the cards which stayed on the needle would go back into the file. The only ones kept out would be those which fell off both times.

On the other hand, to locate code 00, you would start with either hole, but the cards which fell off either time would be returned to the file. All those which stayed on the needle both times would be kept.

This use of several positions of yes-or-no coding is the basis of electronic computers, which also employ the binary system. While it seems almost inefficient, remember that using 6 holes instead of 2 for one code group gives you 64 possible combinations—and 10 holes would give you 1,024 combinations.

Proper coding also makes it easy to put the file in order. Let's say you want it to be in alphabetical order by the author's name. This uses holes 11 through 20 across the top.

For this type of sort, you start with hole 20 and work back to hole 11. Keep the cards which fall free in proper order, and at the end of each sort put those which stayed on at the front of the stack, then sort again.

When you've sorted at all 10 hole positions, you'll find the entire file is in alphabetical order according to the first two letters of the author's surname. Here's why:

Let's suppose your deck has only four cards—one for Joe Jones, one for Q. X. Atler, one for Bill McNamara, and one for W. Green.

On the Hole 20 sort, only Jones' card would stay, since T, N, and R all have 1s in the hole-20 position. At hole 19, N and R would fall but O and T would stay. The order at this point would be: Jones, Atler, McNamara, and Green.

After the hole 18 sort, the order would be Jones, Green, Atler, and McNamara, since at hole 18 Jones and Green have 0s while Atler and McNamara have 1s.

As the sort proceeds, the order changes each time according to the presence or absence of a zero in each card at that position. After the hole 16 sort, the order would be McNamara, Jones, Green, and Atler, and the second-letter sort would be completed. Holes 15 through 11 repeat the same process for the first letter, and after hole 13 the order becomes Atler, Jones, McNamara, and Green. At hole 12 Jones and McNamara fall, and when Atler and Green are brought to the front the order becomes correct.

In this example, since only four names were used, the sort was complete at hole 12. In practice, all 10 sorts must be made to establish proper order.

By the same token, the file can be sorted by magazine and then the sub-deck for each magazine can be put in order by month and year.

By now, you should have the idea of the do-it-yourself IBM Machine, our "73 Selector." Just two words of caution:

When you put one together, you're liable to find yourself thinking in binary code for a while—which may prove helpful if you ever want to work with computers—and

Watch out for the gadget. You may find it fascinating, and you *may* find it obsessing!

. . . K5JKX/6

(M-100 from page 22)

ıodulation of the full rf output. However, for est speech quality the modulation level should e set no greater than where the transmitter's late current meter shows an apparent satura-on point and further advancement of the ıodulation control does not increase the plate urrent. Because no reactive components ap-ear in the modulator after clipping and be-ause the dc coupling between V-3A to V-3B o filter is needed. The low output impedance f V-3B is in keeping with current practices ı order to maintain good waveform and mod-lation linearity.

There are two typical situations in which ıe M-100 is applied. One is the clamped or egulated screen final amplifier operating in ass C, which is illustrated by schematic dia-ram in Fig. 2, and the other grounded grid mplifiers using beam tetrodes or pentodes. In ıe case of the latter, efficiency would be reater through the use of the M-100 for reen modulation than with the grid modu-ıted method commonly used. The manufac-ırer offers to consult with prospective users here they may have a problem concerning onnection to and operation of their equip-ıent.

In addition to tests made with home brew quipment, the M-100 was connected to a Vik-g Navigator which was kindly lent for that urpose by Chuck of Key Electronics in Ar-ngton, Virginia, in order to try it out with typical commercially designed rig in the ands of many Novices, as well as old timers, nd to whom eventual conversion to phone ould appeal.

(Now go to page 50)

(M-100 from page 49)

Step-by-step instructions for the hookup are furnished with the M-100. The only physical change of note is to insure the screen by-pass does not exceed 500 mmf and to replace it with one of that value where it does, as well as to open the screen dc lead at the socket, bringing these two connections to the M-100.

When on transmitter standby (receive) or tune positions, the audio from the loudspeaker would drive the screen of the transmitter through microphone pickup. This was cured by using a pair of auxiliary contacts of the antenna relay in series with terminal 4 of the M-100 so that this circuit is open on receive and closed on transmit.

The spectrum around the carrier when modulating was observed on a Panadaptor and looked clean at all settings on several bands. The modulation patterns were checked with a Central Electronics Multiphase RF Analyzer, and as may be expected, more precise adjustments of carrier and modulated envelope could be made. This is true of any modulated system. 'Scope monitoring of phone transmissions would clean up much of the smog of amateur radio, were it required by regulation. There was no difficulty in obtaining patterns equal to the perfect ones shown in the handbooks. If you do have or can borrow an oscilloscope

(Turn to page 52)

Staff

Powerhouse Pros

Part I

While we're normally agin two-part articles, on the grounds that any technical information should be complete unto itself, this subject is an exception. The field of power supplies is a broad one, not often covered, and our choice was between giving you a power-supply article and nothing else this month, cutting down the detail, or splitting the article into two parts. Rather than compromise the standards of our Technical Article series, we reluctantly decided to split the article. Part Two will appear next month—and either part is complete by itself; you don't have to wait until next month to use the information.

VACUUM tubes and transistors being the choosy gadgets they are, the power supply is a unit common to every item of electronic equipment. As a result, dozens of specialized power-supply circuits have been developed; however, the entire subject is usually disposed of with a few general words in most reference books. Few homebrew power supplies are engineered; the majority of them are simply put together and debugged until they work.

Happily, most of them *do* work—but they can be much more efficient and will accomplish their tasks more easily if they are designed before, rather than after, they're built. The basic principles are simple, and you probably know them already. However, many little tricks can be employed—and that's what most of this article is about.

Before going into the tricks, though, let's take a close look at those basic principles.

First off, we must decide on the purpose of a power supply. Naturally, it's to supply power. Most usually, this power is in the form of direct current, although most vacuum-tube power supplies include provision for low-voltage ac for tube heaters.

Output voltage may be high, low, or medium, depending on the application, and the same goes for current. A supply for a transistorized preamplifier may supply only 5 volts at 1 ma, while one for a kilowatt final may be called on to give forth 2,500 volts at nearly an amp.

Input to the supply is usually 115-volt, 60-cycle, single-phase ac from the house lines, but not always. Big rigs frequently use a 230-volt input, and mobile units usually employ 6- or 12-volt dc. Mobile power supplies are a subject unto themselves because of their special considerations. They won't be gone into further in this article.

With input source and output power determined by the associated equipment and operating site, we can proceed to design a power supply. With so many specialized circuits to choose from, though, we're going to be lost unless we classify the circuits in some manner while examining them.

One method of classification would be into low-power, medium-power and high-power categories, and many references follow this procedure. However, many circuits are equally usable in either of these three groups, so we're taking a different approach. To start, let's decide whether we want to use transformers, or operate directly from the ac line.

Until a few years ago, transformerless supplies were limited to the low-power group because it was impossible to develop even moderately high power through multiplier circuits. However, modern circuit techniques make it possible to dispense with transformers at any level below about 500 watts output if we like.

While most references compare voltage multipliers with transformer-type supplies on the basis of comparative cost, that comparison loses validity in the higher power brackets since the amount saved on transformers is spent on additional rectifiers and capacitors. At lower power levels, cost comparisons remain

(Continued on page 62)

(M-100 from page 50)
or RF Analyzer, by all means do it. The attachment is very simple and observation educational. With the Multiphase, it is preferable to use its 1000 cycle tone fed to the microphone input in order to obtain sync. The .02 volt output should be used as higher levels would cause distortion due to the high gain of the M-100. Once the best settings for carrier and modulation is found, they remained constant for the microphone and plate current settings of the transmitter.

If you have no means of getting to a scope, satisfactory results can be obtained by following the operation instructions which come with the unit. There is a tendency to turn the gain up too high, therefore a critical on-the-air check is necessary in order to reach maximum clarity with maximum punch. Actually the M-100 hooks up much faster than it takes to talk about it, taking only about twenty minutes with the Navigator.

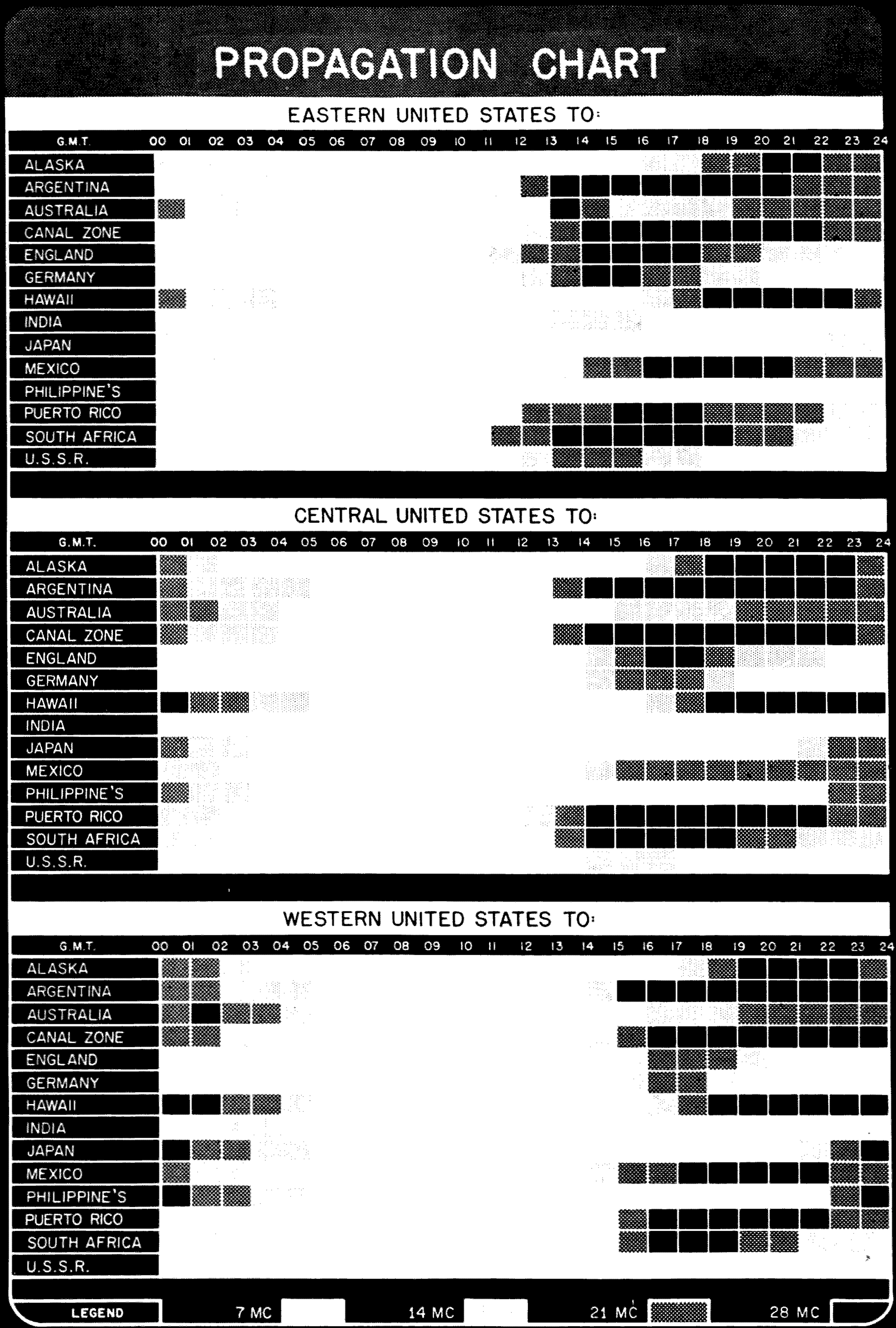
All on-the-air reports were good, even through heavy QRM on 20 meters in the evening, and most hams were surprised at the low power used while running the Navigator.

The brochure speaks of mobile use as a feature, and the M-100 would be ideal to modulate a high power mobile transmitter. It would be my preference to use a transistorized supply with a 115 volt 60 cycle output such as the Heath MP-10, which, while larger than necessary for the M-100 requirement of 30 watts, could also operate a station receiver giving you a quick conversion from shack to mobile, and vice-versa.

The self-contained 1000 cycle tone source gives you ICW capability on UHF, as well as the tune-up source for double sideband suppressed carrier should the unit be reworked for that purpose. The bandpass was checked with a Supreme Model 563 Audio Oscillator, maintaining metered constant output and was in close agreement with the 300 to 4000 cycle range, having a sharper cutoff on the lower frequency side where 60 cycle hum troubles originate.

The general impression gained from operation of the M-100 is that it can find a place in almost any ham shack either as part of the main rig, for portable use or as the modulating source for anything you home brew or test. Many of the features available in the unit are those you would like to have but would not have the patience to incorporate in gear assembled for trial or test purposes.

. . . W4API



PROPAGATION CHART
EASTERN UNITED STATES TO:
G.M.T. 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PUERTO RICO
SOUTH AFRICA
U.S.S.R.
CENTRAL UNITED STATES TO:
G.M.T. 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PUERTO RICO
SOUTH AFRICA
U.S.S.R.
WESTERN UNITED STATES TO:
G.M.T. 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PUERTO RICO
SOUTH AFRICA
U.S.S.R.
LEGEND
7 MC
14 MC
21 MC
28 MC

Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

The bands listed are MUFs and a higher band will not work for the time period listed. Lower bands will work, but not nearly as well. Times are GMT, not local time.

These charts are to be used as a guide to ham band openings for the month of June, 1961 to the various countries listed. I will be interested to hear of your results in using these charts an dto know what other areas you might wish included in future charts.

Advanced Forecast: June 1961

Good 1-2, 4-7, 15-30

Fair 3, 8-9, 13-14

Bad 10-12

REMINDER

Bring this copy of 73 to your next ham club meeting and let everyone see it. Don't forget to show it to hams that come avisiting too. We have been able to get special U. S. Government permission (our postman says OK) for you to discuss articles appearing in 73 with fellows on the ham bands.

The Dx

"LEMME tell ya', boy," old Rufus Jones said to me one afternoon, "there ain't nothin' what's more fun than huntin'. They's fun in gettin' yore huntin' gear ready. They's fun in settin' an' watchin'. They's fun in raisin' yore gun an' pullin' th' trigger. They's even fun when you open both yore eyes an' fine you plumb missed th' varmint you was aimin' at. But mind you, boy, it takes a heap o' figurin' and patience for you to be a good hunter."

Although old Rufus had coon and squirrel in mind when he was talking, his comments can be very aptly applied to the hunting of that elusive quary, dx. Dx hunting can be fun and the number of hams who indulge in this facet of amateur radio certainly prove it. Experience has taught the old timer the signs and trails that lead to successful dx contacts. The new ham with the dx fever in his blood is very often confused and unsure as to how to start adorning the walls of his trophy room with those rare QSL cards that result from successful dx hunts.

First, let's give some attention to what old Rufus would call "huntin' gear." For one thing, high power is not a necessity. Many fellows have and will continue to work the rare ones using less than one hundred watts. The antenna is very important and should be the most efficient possible for your location. This will enable you to hunt with the biggest signal possible for the power you run. As for the receiver, forget about the chrome and icing. If you have one that's both sensitive and selective, who cares how fancy it looks.

Now that you've got your "huntin' gear," where to hunt is the next question. That's easy! If you look in a copy of "73" magazine, you'll find a "hunter's almanac" that Wayne calls a "Propagation Chart." A little study of this chart will tell you when and where to hunt and what for.

After you've got your gear warmed up and you're tuned up in "huntin' territory," the "sittin' and watchin'" begins. Don't get impatient! A deer doesn't jump out of the brush the minute you sit down and cock your gun. It's the same with dx. Assuming for the mo-

Hunter

Ken Johnson W6NKE

ment that you're on cw, tune slowly up and down the band. Listen carefully to the weak signals and don't ignore the strong ones. That S9 signal you just passed could be a rare one with a skip "pipe line" right into your location. Listen, listen, then listen some more. No doubt you'll hear some of the fellows calling cq dx and get the yen to try it yourself. The chances of raising a dx station in this manner are small. The law of averages is agin' it. In addition, it creates QRM for the other fellows and you could easily be on top of a rare one and louse things up for them. More than once, I've had a good dx contact ruined through someone calling cq dx right on the frequency.

When you do hear a choice one, twist the dial on your VFO and zero in on his frequency. When he signs, call him and be sure that your first is good, clean and easy to copy. Don't call his call too long, three or four times and the same with yours, is plenty. Take a listen and tune a little each side of the frequency. Either he, your receiver or both might have drifted slightly. If he doesn't come back, call him again. Keep up these short calls and listening periods until he does come back to someone or calls cq again. Don't give up, call him again in the latter case. If there are several other stations taking a shot at him too, keep after him. You've always got a chance until he comes back to someone.

If another station nabs him, either stand by and wait for him to finish his QSO or hunt elsewhere on the band. Don't try and break in on a dx QSO. Many dx stations will refuse to recognize or come back to a station that tries to break in on their contacts. Wait until he finishes his contact and call him again. It may take two or three standbys but with courtesy, persistance and patience, you've got a good chance of bagging him.

When you make a good shot and get a contact, keep your transmissions short and match your speed to that of the other operator. Over long distances, the band conditions can change in the twinkling of an eye. By keeping transmissions comparatively short, you lessen the

(Turn to page 58)

(From page 57)

chances of losing the contact during band changes and fluctuations. When the QSO is finished, move off the frequency and let another station have a chance.

Working dx on AM phone is a different proposition. Many of the dx stations operate in the cw portions of our ham bands, so it is impossible to zero beat their frequency. The system in this case is to tune up near the low frequency ends of the American phone bands and call them from there. The closer you get to the edge of the band, the more QRM you will encounter. It's like opening morning of deer season. Every hunter is down there aiming at the comparatively few dx stations available. Even if you are putting in a good signal at the distant location, yours is probably one of many and the QRM is terrific. It's a good idea to tune up on a frequency considerably above the low edge of the band and call from there. Some dx operators actually tune from the top of the American phone bands to the lower end hoping to get a call from some station that's operating above QRM alley. I've had them thank me for calling from such a spot as they haven't been able to make out a word through the QRM near the lower edge. Try it, it works.

You, like everyone else, want a QSL to prove the success of your hunting forays. Here's another hunting tip that gets results. When you send your card, put it in an envelope, enclose a self-addressed, envelope and as many IRC's (International Reply Coupons) as necessary to cover the return postage. These can be purchased at any U. S. Post Office. Help the dx operator and yourself by sending your card in this manner. Then have patience and wait! Put yourself in the position of the operator of a dx station. Nearly every station he contacts wants a QSL. It costs him money to have the cards printed, the volume of postage stamps is costly and the amount of time required to check his log and make out cards is tremendous. These fellows are really faced with a job and everything you can do to help them will be appreciated.

You may spend hours fruitlessly scanning the bands for dx. Sometimes you may work one station, while at others you'll work them one after another. As old Rufus said, "it takes a heap o' figurin' and patience to be a good hunter, but it's fun!"

. . . W6NKE

(Propagation from page 18)

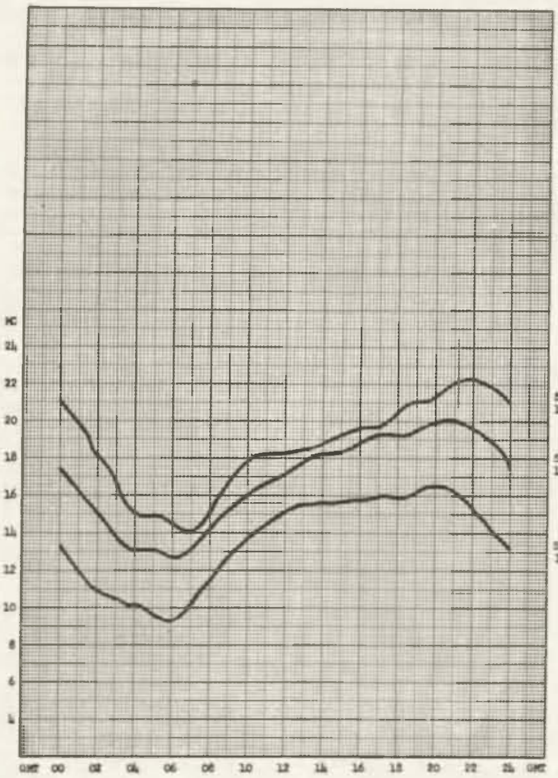


Fig. 6 explains why there are no openings this Summer to England except in the 14 mc and 7 mc bands.

I hope that the curves presented in this analysis have given you a better and clearer understanding of the variations in MUF and how the HBF for the Propogation Charts are determined. Because of all the Pros and Cons heard on the ham bands these days about 10 meters going to be dead this Winter, I have prepared a Special Propagation Chart for this coming Winter. This chart will give you an idea of what to expect over the 42 different paths, and as you can see, I expect quite a great deal of 10 meter activity.

Part III will show the influence of antenna height on Propagation for the different Ham Bands. . . . K2IGY

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(Power from page 51)

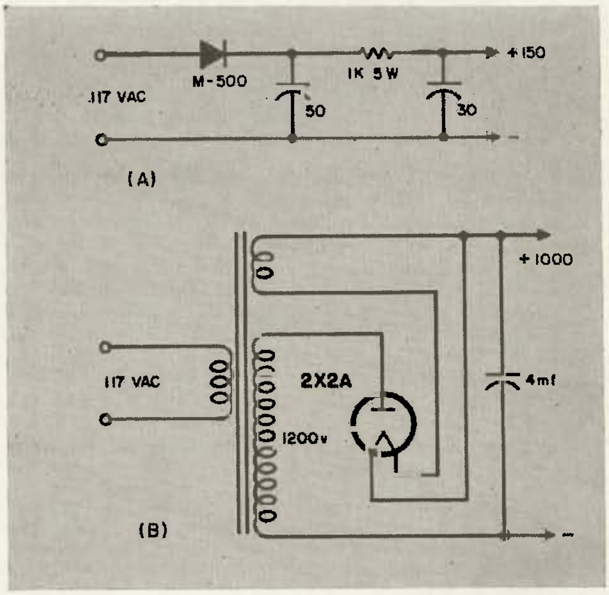

Fig. 1

valid.

More important points of difference are the magnetic fields produced in the vicinity, and safety considerations. Any power transformer will radiate strong magnetic fields, which wreak havoc in low-level audio and electron-beam-tube circuits (including SSB exciters of the 6AR5 or 7360 type as well as oscilloscopes and tuning indicators). On the other hand, all voltage multiplier circuits are tied directly into the 117-volt power lines in one way or another, thus making it possible for you to—either by carelessness or by component failure—become connected bodily to the almost-unlimited power there residing. At best, you'll get a shock. At worst, it could be fatal. Equipment, also, is subject to possible damage through interconnecting ground cables which may short out part of the power supply.

In sum, the transformerless supply offers freedom from troublesome magnetic fields, at the price of increased danger to both operator and equipment.

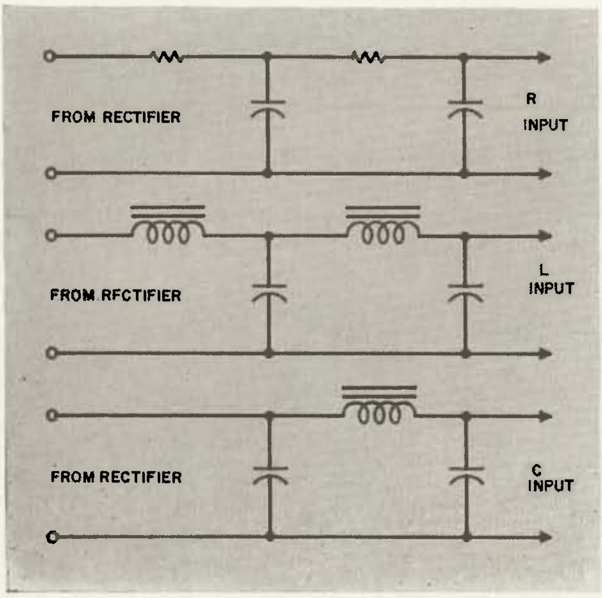

Fig. 2

If use of a transformerless supply appears best, one way of avoiding the danger is to install an isolation transformer (cost, about $10) in the supply line to the power supply. This can be located far enough from the equipment to avoid magnetic fields, while providing isolation from the regular 117-volt line.

Another major classification which doesn't appear to be so obvious is between power supplies using vacuum tubes as rectifiers, and those employing semiconductor diodes. While the general circuit configuration is similar, the operating conditions of the two types of units differ radically.

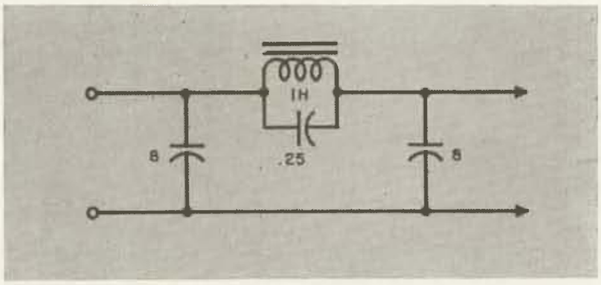

Fig. 3

A vacuum diode requires filament power, produces quantities of heat, and has a built-in voltage drop ranging from 15 to 50 volts. Semiconductor diodes require no heater power, run comparatively cool, and have an average voltage drop of about 1 to 3 volts.

However, semiconductor diodes require current-limiting resistors and an adequate heat sink, neither of which is necessary with a vacuum tube. Semiconductors, also, may subject filter capacitors to higher voltage levels, due to both the lower rectifier drop and the instant action when the supply is turned on.

Another point which must be watched with semiconductors is that of peak inverse voltage. Vacuum diodes are most tolerant of excessive reverse voltage; even the lowly 5Z3 is good for more than 1,500 volts. Semiconductors, however, will be destroyed by even slight overdoses of excess reverse voltage—and the most common types are rated for only 400 volts. This is equivalent to about 250 volts RMS, which means that units must be connected in series for medium- to high-power supplies.

Therefore, the choice between using vacuum diodes and semiconductor rectifiers must be made on the basis of a number of factors. Schematic diagrams in this article show them used interchangeably, and one may be substituted for the other in any circuit provided that the differences are allowed for.

Possibly the most common of all power-supply circuits is the half-wave rectifier, shown in Fig. 1. The usual circuit configuration is

(Turn to page 64)

shown in Fig. 1a, and a variant for high-voltage use in Fig. 1b. Here's how it works:

A diode, by definition, can conduct only in one direction. Again by definition, this conduction occurs only when the anode is positive. With an alternating current applied to the input, the diode is almost a short circuit whenever the anode is positive and is an open circuit when the anode swings negative.

Whenever the diode conducts, a pulse of current flows through it into capacitor C. When the diode's anode is negative and the rectifier becomes an open circuit, the charge on C remains stationary. These actions occur on alternate half-cycles of the input current; the diode's one-way-gate action turns the ac input into pulsating direct current.

It's clear that only half the input wave is used; the other half is blocked and never appears in the output. The pulses of direct current occur at the same frequency as the alternations of input current polarity. Use of only half the wave means that efficiency can never exceed 50 percent, and the low ripple frequency present in the output means that adequate filtering (which we'll go into later) is difficult to achieve. For these reasons, the half-wave rectifier is limited in application. No other power supply circuit is so economical with

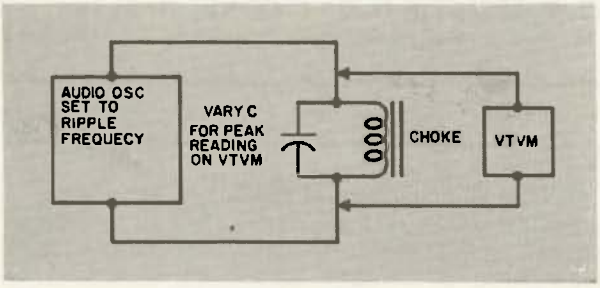

Fig. 4

parts, but virtually every other circuit gives better efficiency and output.

Before going on to other circuits, though, let's take a look at the filter since it's as important to a power supply as is the rectifier circuit. A common filter circuit is shown in Fig. 1. However, comparison between the three major types can be seen more easily in Fig. 2.

The basic purpose of any filter circuit is to remove the ac component (usually called ripple) from the rectifier output. Without a filter, the output consists of pulsating direct current. The filter smooths out the pulses into something approximating pure dc.

It's important at this point to emphasize that *no* filter can ever turn rectified ac into completely pure dc. Even the most elaborate (and costly) low-impedance highly-regulated power supplies still have a trace of residual ripple in their output. However, it *is* easily possible to reduce the ripple so close to zero that for all practical purposes you can't tell the difference.

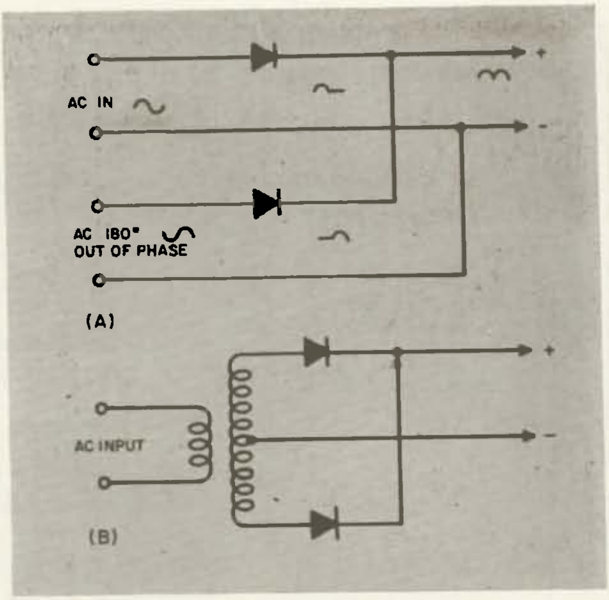

Fig. 5a and b

How much ripple to tolerate is determined primarily by the purpose for which the supply will be used. Most published circuits and charts are based on a 1-to-5 percent ripple figure. This is far more filtering than necessary in some applications and not nearly enough in others. For example, the power supply for the first audio stage of a high-gain modulator (such as might be used with a low-output dynamic mike) should probably contain less than 10 millivolts of ripple. If the supply voltage is 100, this works out to 0.01 percent residual ripple.

On the other hand, the supply for a class B modulator operating at the 500-watt level would be perfectly acceptable with as much as 25 to 30 volts ripple, at a level of 1000 volts and provided that the modulator were push-pull.

In design stages, the best bet is to work for a nominal 1-percent ripple figure. This can be modified upwards for high-voltage supplies if component cost starts to skyrocket. Then, when the supply is finished, if ripple proves objectionable another filtering stage can be added. Like amplification, the effect is multiplied rather than added, so one extra stage will usually do the trick.

Now to the three types of filter circuits. They're usually classified according to the input elements as capacitor-, resistor-, or choke-input filters. From the circuit-theory viewpoint, they divide into pi- and T-section networks (by lumping the choke- and resistor-input filters together).

While they accomplish the same end, they go about it in different ways and each has its own application. The capacitor-input filter uses the comparatively low ac impedance of the input capacitor to do the bulk of its filtering. The resistor- and choke-input types use the high impedance of the input element to block most of the ripple from the output.

The capacitor-input unit, therefore, presents a heavier load on the rectifier circuit than either of the other types. This means that (theoretically at least) either of the other types can produce more usuable output current from a given rectifier than can the capacitor-input. In practice, the resistor-input filter is limited to low-current applications since its input element offers just as much resistance to dc as to ac.

Tending to balance the ledger to some degree is the fact that, *under light loads*, the input capacitor of the capacitor-input filter tends to charge up to the peak ac supply voltage and to remain charged to almost this level during operation. The choke-input unit, on the other hand, has a tendency to give output at approximately the RMS input level because its impedance is highest when voltage applied to it is high.

Therefore, for a given rectifier circuit and under light loads, the capacitor-input filter provides a higher output voltage than does the choke-input unit. This is the main reason for its popularity in commercial circuitry. However, under heavier loads the advantage disappears, because the capacitor is discharged partially during each "off" cycle of rectifier operation.

The effect shows up as poor regulation under load for the capacitor-input unit as compared to the choke-input type, which together with the current-capability characteristics of the choke-input filter swing the balance far in favor of choke input for heavy, varying loads such as are found in transmitter operation. Receivers, audio equipment, and test gear, on the other hand, usually benefit from the higher voltage capability of the capacitor-input filter and present a load constant enough that the regulation isn't harmful.

No matter which type of filter is used, one section of filtering usually isn't enough. For most efficient results, the rule in adding extra sections is to use the *other* type of filter for the second section. That is, if the first section is choke-input, the second would be capacitor-input. The capacitors of the two sections are physically merged into a single unit, presenting the familiar ladder-circuit form.

Since most filter circuits involve both capacitance and inductance, they have some reson-

(Turn to page 66)

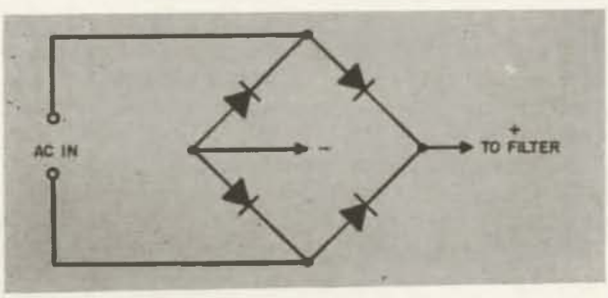

Fig. 6

ant frequency. If this frequency is near the ripple frequency, anything can happen. The best rule is to make certain that the resonant frequency is at least an octave lower than the ripple to avoid trouble.

However, resonance in filters can occasionally be used to advantage. One example is the old BN radar, used as an IFF unit by the Navy throughout World War II. Its power supply used a resonant choke, tuned bv a 0.25 mfd capacitor, to block 120-cycle ripple current. This enabled use of a smaller choke than would otherwise have been necessary. The circuit is shown in Fig. 3. However, capacitance values must be determined by experiment for the individual choke. The setup for picking the proper capacitance is shown in Fig. 4.

After this swing through filter circuitry, let's go back to the rectifier and see what we can do to increase efficiency. As we saw, the half-wave circuit effectively threw away half the input power. Now if there were just a way of using that other half-cycle, we could double power output.

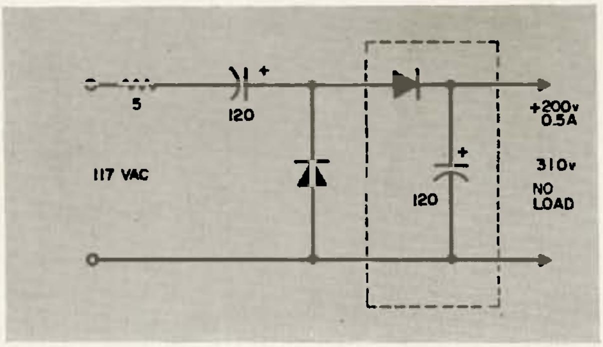

Fig. 7

By reversing phase of the input power and putting it through another half-wave circuit connected in parallel with the first, we can do just that. The developmental circuit is shown in Fig. 5a, and the same circuit in its more-familiar form appears in Fig. 5b. As can be seen from Fig. 5A, the circuit operates in a manner almost identical to the half-wave unit but twice as often.

The full-wave rectifier picks up another advantage besides higher power; since it operates twice as often as a half-wave circuit, the output pulses occur twice as rapidly, which means that ripple frequency is twice as high as the input. This allows us to use smaller filter components to accomplish the same purity of output.

Because of these advantages, the full-wave rectifier circuit is the one most widely used in all types of electronic equipment with the exception of entertainment radio and TV sets, where cost considerations make the transformerless half-wave circuit attractive for ac-dc radios and the necessity for eliminating magnetic fields make other transformerless circuits popular for TV.

However, the familiar circuit of Fig. 5b is

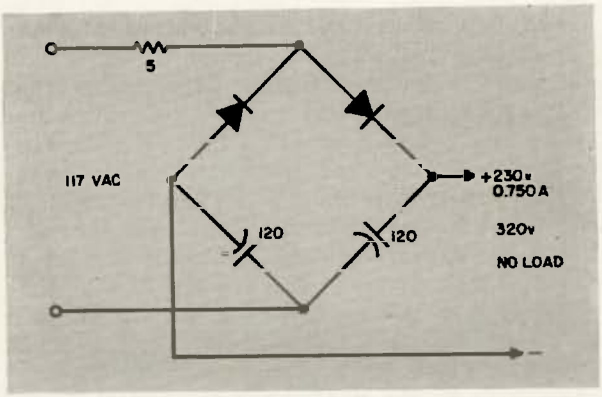

Fig. 8

not the only full-wave rectifier. Another one, long popular for low-voltage applications and now gaining popularity for other uses since the advent of semiconductor rectifiers, is the bridge shown in Fig. 6.

Unlike the preceding full-wave circuit, the bridge rectifier bears little resemblance to a half-wave circuit. It utilizes the gating property of its rectifier diodes to steer the ac input in the proper direction, depending on polarity.

Obvious disadvantages are the need for four diodes instead of two, and slightly greater circuit complexity. However, the transformer used can be smaller by half than is necessary with the ordinary full-wave—and the bridge can be used without transformers where the ordinary full-wave cannot. However, in this case B— will not be connected to either side of the line directly but will be at a potential halfway between B+ and the line. This is no advantage—it adds to the dangers rather than detracting from them.

The extra diodes aren't so much of a disadvantage as they might appear, since each can be smaller than would be used otherwise (they're in series at all times for the rectified current).

Before going further, let's compare the input voltage and the dc no-load output voltage for each of the three circuits we've examined so far. With an arbitrary input, the half-wave rectifier will give us approximately the peak-ac value of the input as its dc output. The center-tap full-wave will give us something less than half that output, although it provides twice the current. The full-wave bridge gives approximately the same voltage and current output as the half-wave circuit, but wastes less input power doing so.

What happens if we need a higher dc output voltage? Of course, we can always use a different transformer if we've chosen to build transformer-type power supplies, but if not, then what?

Fortunately, there are circuits not too distantly related to the bridge which can multiply input voltage. One of the earliest of these (which made the table model radio possible way back when) is the half-wave doubler.

The circuit is shown in Fig. 7. Note that

the lower part of the circuit, enclosed in dotted lines, is similar to the half-wave circuit already discussed. The remaining components, also, form another half-wave circuit. Output voltage of the two separate circuits is taken in series, giving twice the peak-ac input value on light loads. This means that such a doubler operating from standard house lines will give about 300 vdc at no load.

The major disadvantage of this circuit is that output falls off rapidly with load. On top of that, it has all the other disadvantages of half-wave circuitry.

Another doubler circuit, once popular in TV sets but seldom used now, is the full-wave doubler shown in Fig. 8. Note its resemblance to the full-wave bridge rectifier.

In operation, each capacitor is charged by one diode, on alternate half-cycles of input. When one diode is "off" the other is "on," using both halves of the input cycle. The two capacitors, each charging to peak-ac input voltage value, are in series, making the no-load output equal to twice the peak input value.

Like the half-wave doubler, output falls off with heavy loads, but the full-wave circuit will take more load than the half-wave for the same voltage output because of its higher efficiency. Using semiconductor diodes and extremely large capacitors (300 mfd each) the fullwave circuit will deliver 260 volts at 500 ma, where at the same load the halfwave output is only 225 volts. Halfwave output voltage drops to 210 at 1-amp output, while fullwave is 245 at the same current.

The reason for the full-wave doubler's fall from grace in commercial TV design had nothing to do with any basic circuit flaw; it just put too much strain on heater-cathode

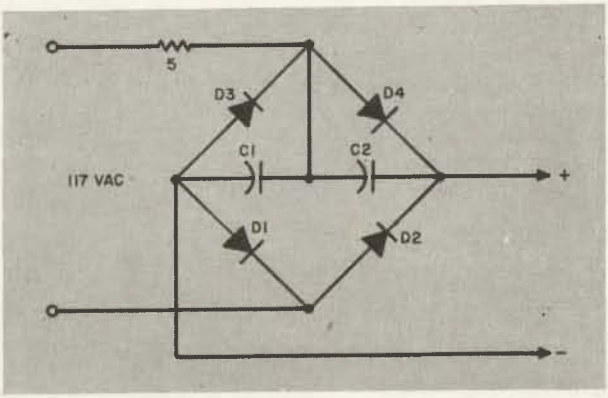

Fig. 9

insulation when tube filaments were arranged in a series string. If filaments are supplied from a separate transformer you should have no trouble with the circuit.

If still higher output voltage is needed, either the half- or full-wave doublers can be extended to triple the input voltage. The full-wave tripler circuit is shown in Fig. 9, and

(Turn to page 68)

(From page 67)

the half-wave tripler in Fig. 10.

The full-wave tripler is seldom used—possibly because it is so little known. Its advantages over the more-common half-wave tripler are those of any full-wave circuit over an equivalent half-wave arrangement, yet most reference books fail to mention its existence and no commercial design using the circuit could be located.

In operation, diodes D1 and D2 together with the two capacitors form a full-wave doubler. In addition, all four diodes act as a fullwave bridge, independently charging first one capacitor and then the other to peak line voltage. Since capacitor charge is additive, the result is tripled voltage at the output.

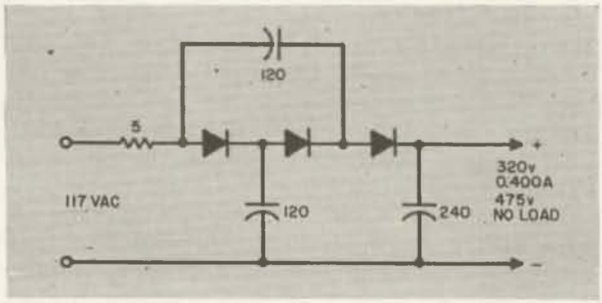

Fig. 10

The half-wave tripler of Fig. 10 is similar in action to the doubler of Fig. 7, with an additional diode and capacitor added in series. In fact, this circuit can be extended as far as you like, to give "n-fold" multiplication of input voltage, but regulation drops rapidly as the voltage output climbs. One version, using 8 diode-capacitor pairs to give a nominal 900-volt output suitable for oscilloscope use, is shown in Fig. 11.

So far, we've looked at the basic power supply circuits, filters, and voltage multipliers. We're a long way from being finished. Coming up in Part II, next month, are voltage regulators, both active and passive; a tricky filter circuit which eliminates chokes; some ultra-miniature power supplies, and several surprises.

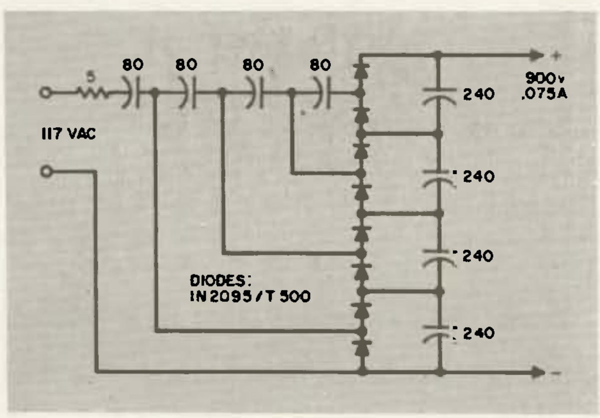

Fig. 11

Advertisers Index

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Algeradio ... 63
Alltronics-Howard ... 49
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Barker & Williamson ... 49
Barry Electronics ... 67
British Radio Electronics Ltd. ... 68
Candee ... 65
Centimeg ... 68
Central Electronics ... 7
Clark ... 52
Clegg ... 2, 27
Columbia ... 45
Curta ... 10
Cushcraft ... 56
Ebco ... 5
EICO ... 11
Electro-tone ... 53
Elmac ... 58
Epsilon ... 57
E-Z Way Towers ... 13
Finney ... 6
Fulton Radio ... 47
Globe Industries ... 56
Gonset ... Cover II
Graham ... 56
Ham Novelties ... 43
Heath ... 19
Hi-Par ... 50
House of Antennas (J-Beams) ... 45
International Crystal ... 1
Jefftronics ... 69
JSH ... 45
Lafayette Radio ... 23
L-W Electronics ... 45
Mini-Products ... 70
Mission ... 47
Mobiliers ... 43
Multi-Products ... 58
National Radio ... Cover IV
Neil ... 63
Peterson ... Cover III
P & H ... 57
Radio Bookshop ... 60
Reyco ... 56
Rider ... 15
Ritco ... 43
RTTA ... 69
Spera Electronics ... 52
Subscriptions ... 6
TAB ... 71
Tapedcode ... 50
Tapetone ... 43
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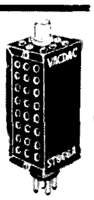

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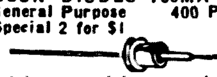

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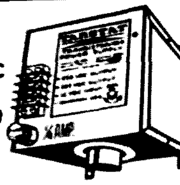

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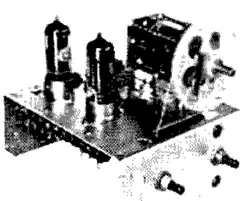

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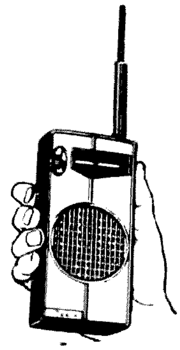

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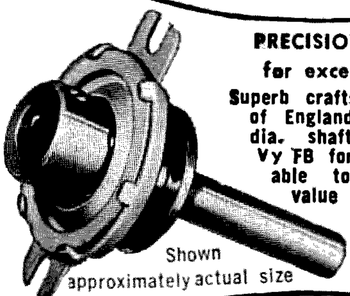

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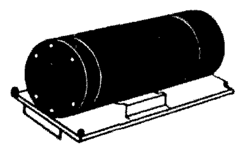

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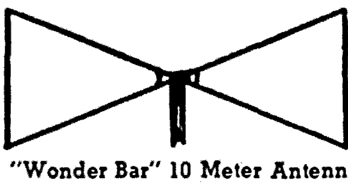

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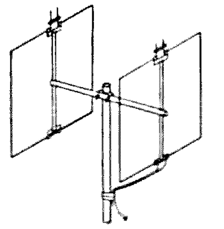

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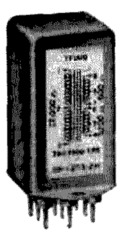

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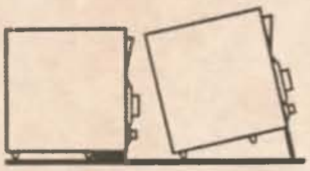

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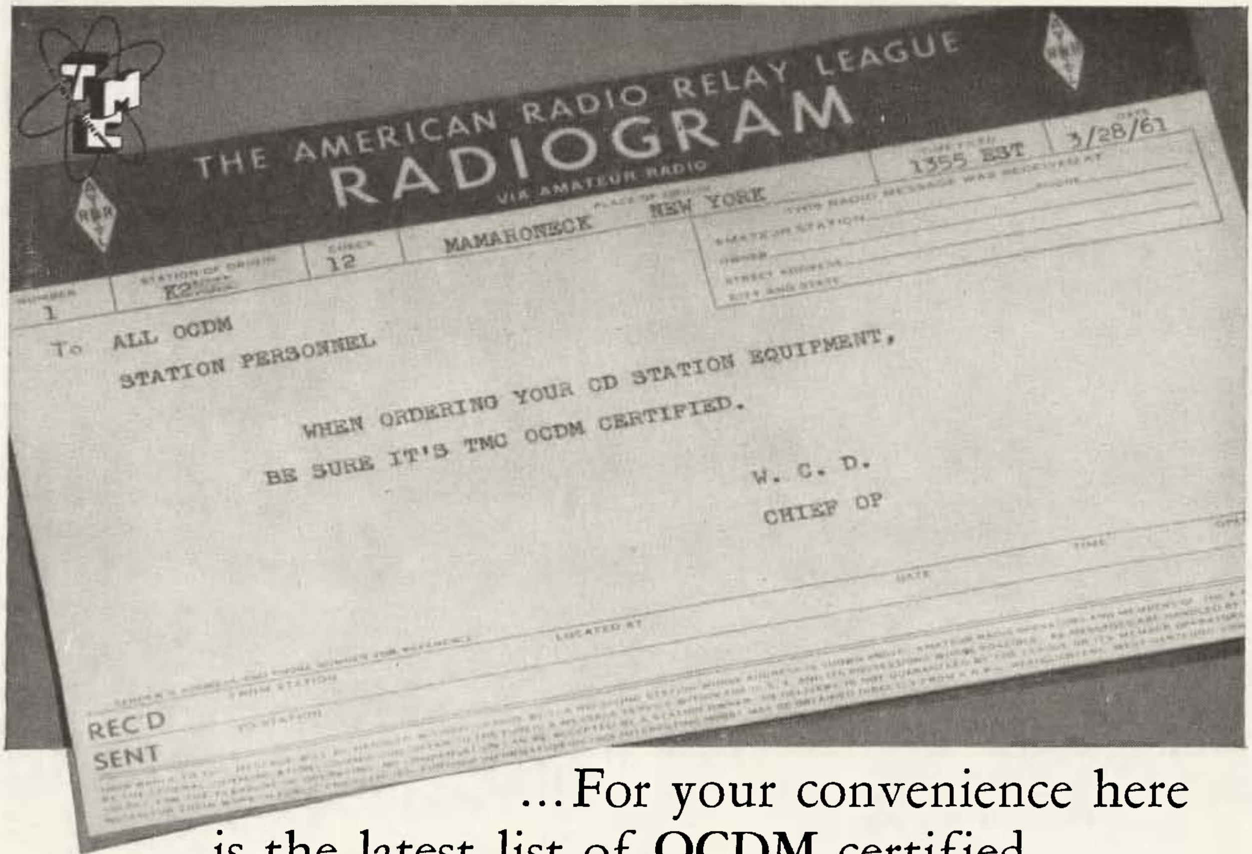

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	GPR-90RXD	SSB 205
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73 Magazine

1379 East 15th Street
Brooklyn 30, N. Y.

July 1961
Vol. I, No. 10

Table of Contents

A Tinker-Toy for Two .... William Smith K8LFI 8
Two meter antennas made out of aluminum tubing and a Tinker-Toy set.

Ready-made Emergency Antenna .... R. E. Baird W7CSD 12
New, improved type mobile antenna. Really works out!

Two Meter Line Amplifier .... Frank Bullock 14
Nuvistor pre-amplifier for hottening up your two meter converter.

Amplitude Modulation Systems .... R. E. Baird W7CSD 18
Review of A-M systems with special reference to an oldie you'll like.

Globular Calculations .... G. T. Martin K5RPB 26
How to find out how far it is from anywhere to anywhere, great circle route.

An S-Meter for Your Sixer .... Alan Bierbaum K5VMC 28
Or your Tenner . . . or your Twoer. What? You don't have one? Heath advertises.

VLF—Very Low Frequencies .... Bruce Boyd W3QA 29
A converter for the 10-100 kc band.

Little NIC Six Meter Converter .... John Sury K8NIC/5 31
Quite wee transistorized converter. You'll like. Real quick project for you.

Panadapting Adaptor, Part II .... John Ellison W6AOI 33
Construction and alignment details.

Plate Modulate Your DX-40 .... Fred Blechman K6UGT 39
How to hook in an external modulator for more output from the DX-40.

Socket for the 4-1000A .... Charles Spitz W4API 41
The tubes are available surplus, but the sockets . . . ouch! Here's an answer.

Frequency Measurement .... C. L. Henry 42
Measuring frequency with simple equipment.

From My Side of the Counter .... Seymour Denby W2BNW 44
Confession from the heart of Radio Row in New York City.

Transistor Biasing Simplified .... Roy McCarthy K6EAW 45
The problem . . . the solution.

Powerhouse Pros, Part II .... Staff 48
Designing a power supply instead of throwing it together.

Propagation Chart .... Dave Brown K2IGY 56
What bands when, to where.

Band Edge Marker .... A. DePascale K1NFE 58
3.5 mc oscillator gives band edge marker for all ham bands.

Transformer Action Demonstrator .... Mike Barlow W8KTJ 64
Very handy for schools and theory classes.

Misc.:

Contents 3
Editorial 4
Letters to Editor 15, 25, 51, 52
Tuning tool for Viking 30
Improving Sx-111 for SSB 32
Test Leads 40
RTTY 57
Other Ham Publications 66

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. . . de W2NSD

(never say die)

May Votes

Angel W2NQS took an early lead in the May voting and kept increasing it to a total (so far) of 1782 votes! The Big Technical Article (Staff) placed second with 1435 votes. I'm real proud that our technical articles are so well received. This bodes well for the whole basic concept of 73. G4 Zed Smith was third with 1119 votes. A few mild grumbles about this issue being a little light may be the result of our having nothing much for VHF this time.

The June votes are piling up for Bill Ashby K2TKN and his Abe Lincoln two meter antenna. If you haven't voted for June yet please send in the card quickly.

Breaking Even

One of the first in-person questions I get at conventions, as I mentioned a few months ago, is how're we doing? That break-even point that we were aiming for turned out to be very flexible and has been following us very closely. Sometimes I think it is preceeding us, but a tote of the accounts receivable put it back in place . . . if we ever get some of the receivables.

Our biggest problem is the prodigious amount of work to be done. Two of us are doing the same work that is full time employment for from 15 to 20 people on other magazines, plus all the extra work involved in getting to every major convention and many smaller hamfests, keeping up a steady stream of promotion to possible advertisers and parts distributors who should be selling the magazine on their counter, and little additional chores like our monthly postcard which has to be octsected and sorted.

I'm not pushing for sympathy so much as maybe a little help. I have to admit that so far we have been working just for the fun of it, with all of the proceeds going to authors and our printer. If you're within commuting distance of our office (?) and have time on your hands we can keep you just as busy as you care to be. Some of the available chores: cutting and sorting those readers request cards; counting article votes; bookkeeping; filling back issue orders; addressing stencil changes; keeping the HQ station on the air; emergency trips to New York City; processing subscriptions; typing subscription stencils; sending out promotion letters; invoicing; statementing . . . plus lots more. Any takers? I thought not.

Looking Ahead

The topic for today is the Geneva Conferences. Before I plunge into the matter at hand I would like to just make a word of explanation: please forgive me for being rather terse. It is against my nature to carry on at length about things. I get a bit worried when I find that I have written about some event, taking perhaps a page to cover it, and then I read about the same thing in another magazine where they have made a six page article on the subject. I suspect that the six pager carries more weight even though it may say the same things that I did. So, on to Geneva.

We went into the 1959 Geneva Conference with much forboding. Many countries had announced plans for cutting back the ham bands and there was much gloom prevalent in official Washington circles. While the Government was behind us, in a manner of speaking, their support left a vast amount to be desired. What it amounted to was this: everyone was 100% for ham radio, right down the line . . . unless frequencies happened to be chopped from any other service, in which case the chopping would be reflected to the nearest ham band, just as it had when we lost 14,350-14,400 kc.

With so many strikes against us, plus the fact that we (the amateurs) went into Conference without a single request for extra frequencies, if for no other purpose than to provide us with a minimum bargaining position, how come we came out in such good shape? The U. S. position with regard to most frequency assignments, particularly in the shortwaves, was for a status quo agreement which would put off any major changes until the next Conference, probably in 1964 or 1965.

The present assignments had been made many years ago, back when few countries had much in the way of radio communications. In the interim the need for radio in these countries has mushroomed and they are still stuck

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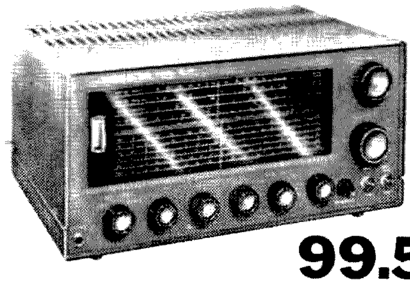
THE LAFAYETTE HE-30 Professional Quality Communications Receiver



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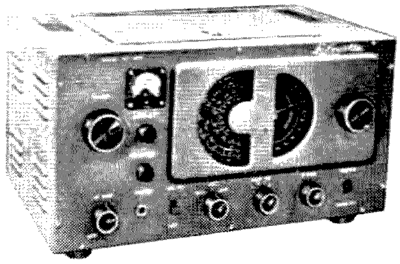

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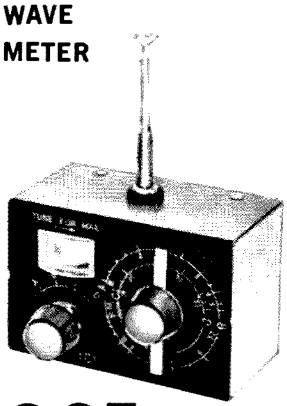

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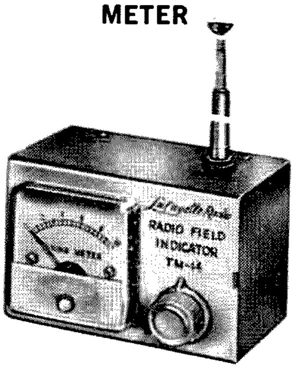

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with a mere handful of frequency allocations. Thus, at the Geneva Conference, where every little country had the same weight vote as the U. S., and re-apportionment of frequencies would in all probability wreck severe hardship on the U. S., you can understand why the U. S. was all for putting everything off for a few more years: anything else would have cost dearly in allocations.

The U. S. was in a pickle when the Conference started because our delegates knew that they were in for trouble from the smaller countries. The one unknown was the U.S.S.R. and all of the votes that they swing. Russia, as ever, had not tipped its hand before the show.

This was the one imponderable of the whole conference, so they got to the point quickly. The U. S. got a friendly country to propose the doctrin of status quo for the short wave bands almost as soon as the opening session of the conference began. There were loud sighs of relief when the Russian Delegate got up and expressed complete agreement with the proposition. That was it, we were safe until the next conference. From then on it was just a question of a few thousand committee meetings to thrash out administrative problems of international communications and some VHF allocations.

We don't know whether the Russians had planned this move for their own benefit, or whether the agreement was a result of the sweetness and light movement then afoot in the wake of the Krushchev-Ike visit. Whatever the motive, it sure pulled our hash out of the fire.

What Next?

Will the U. S. go into the next Geneva Conference as unprepared to hold onto amateur frequencies as we did last time? Well, I know of nothing as yet afoot which would be of advantage to us. Let us hope that we develop some aggressiveness about this . . . you can bet that the other competing services are going to be as aggressive as they can. But *what* can we do?

Well, I've a suggestion. I'll probably be blasted all over the place for it, but then I've been lambasted before. We amateurs have one big advantage over all other services: ubiquity. I think we can take advantage of this.

The services claim that their frequencies are all in use. Perhaps we could organize some sort of world-wide all-band listening program which would for the first time actually establish the real use of frequencies by all services. To the best of my knowledge nothing like this has been done before . . . and I've asked about this among the delegates from many countries and just about all of the various branches of the U. S. government.

(Continued on page 62)

To the hundreds of Hams who have taken the time to write, we at EICO can only say...

FROM THE BOTTOM OF OUR HEARTS, THANK YOU

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Milton Stanley
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Sincerely,

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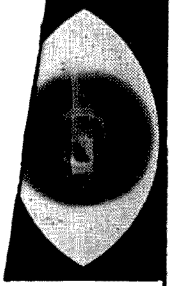

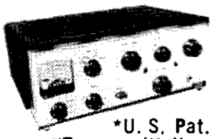

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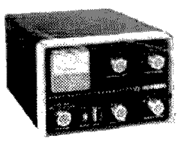

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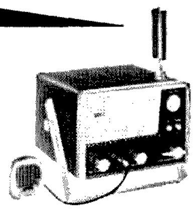

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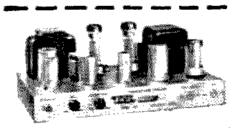

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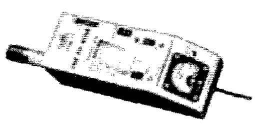

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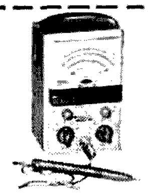

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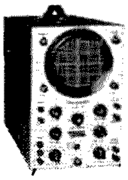

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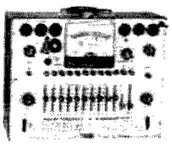

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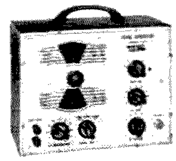

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Tinker Toys for Two

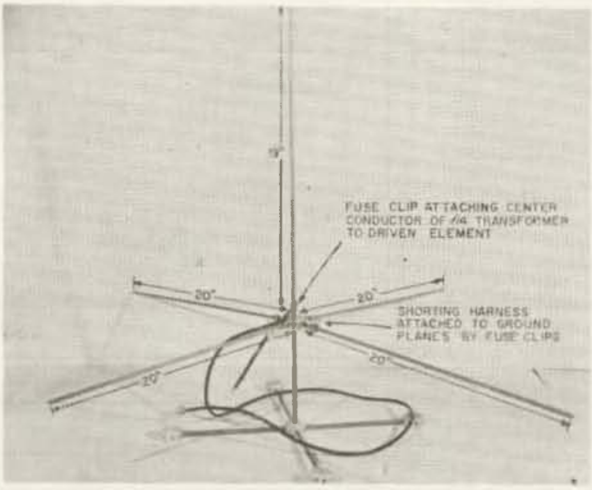
Photos by Bill Kunz

Do you travel a lot (or a little)? Are you frequently (or infrequently) stuck in a hotel or motel room in a strange city at night? If so are you bored with watching television, reading newspapers and magazines, frequenting the nearby bars or movie houses, alone? Those of you who recognize these symptoms know that there is no lonelier feeling than being away from friends and family under such circumstances. Such isn't the lot of a ham, however, if he has his equipment along. He looks forward to each new city eagerly for the new contacts he will make; the new friends he'll accumulate and maybe even the invitations for personal visits he'll wangle.

The increased occupancy of the VHF bands and the advent of the Gonset Communicators, which would load a coat hanger or a hotel window frame, did much to alleviate the aforementioned loneliness for those who could afford a "Gooney Box" or could squeeze the added weight into their airline allotment. The introduction of the Heath series of transceivers has removed both the cost and weight problems for most travelers with the result that many hams carry these little rigs with them wherever they go.

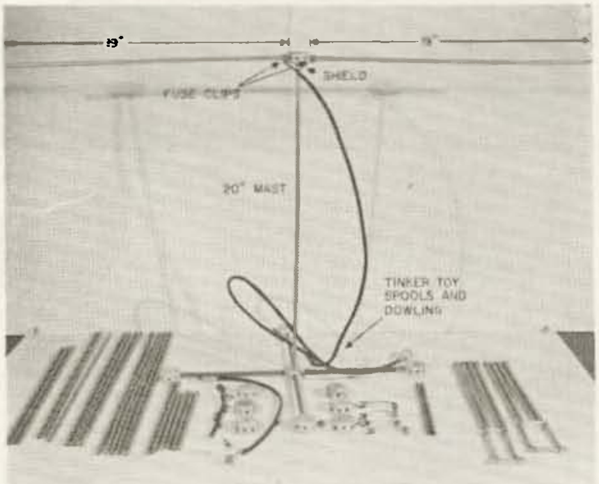
Up until now, however, antennas have been a problem with most operators using either a simple vertical or a dipole set up in a hotel window.

Because of the size of ten and six meter antennas and because of the rapid growth of the two meter band for short range work, particularly in the larger cities, it was decided that efforts would be concentrated on the development of a series of highly efficient, easily assembled, light weight two meter antennas for portable use with low powered rigs such as the Heath Twoer. Thus evolved the Tinker Toy idea of antenna construction and assembly.



Dipole

The heart of the system, of course, is a ninety-eight cent set of Tinker Toys available at any Dime Store. This set provides the base for the antennas plus all the insulating connections required. The wood in the Tinker Toy kits is well seasoned and dry thereby offering excellent insulation even at Two Meters for the type of use described in this article (indoors with low power). If higher power or outdoor use during field day is contemplated two of the Tinker Toy wheels can be replaced by similar



Vertical Ground Plane

wheels cut and drilled from 1½ inch diameter polyethylene or polystyrene rod available at most radio supply houses. Insulation is needed only for the driven elements.

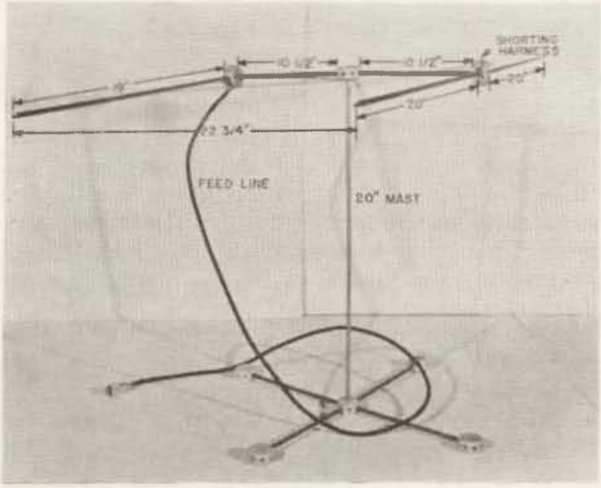
The holes in the Tinker Toy wheels are a little small and too shallow so they should be drilled out further with a ¼ inch drill to give a snug fit with the tubing used.

All the elements and the mast for the various antennas are carefully pre-cut to exact length with a tubing cutter from ¼ inch OD by .035 wall hard drawn aluminum tubing. This tubing may be anodized in which case it should be scraped at points where electrical connections are to be made. This material is available at your hardware store for about twenty cents a foot or about $1.75 a pound if you have a wholesale connection. A twelve foot section of the material weighs 0.34 pounds, need I say more? About 36 feet of this tubing

is required to make the elements described in the parts list with a total weight of about 1 pound and costs under $2.00 (at the wholesale price). As a matter of fact, less than $5.00 worth of total parts and three pounds of weight are involved in the entire project. The parts list below includes enough materials to build more than five different antennas for two meters ranging from a simple dipole to a cubical quad and giving the experimenter a number of configurations to try under various conditions in order to obtain the desired communciation results.

All the antennas are designed from standard hand book dimensions and are calculated to present feed point impedances of approximately 72 ohms so that they may be fed directly with RG-59-U coax. The feed line is cut to an exact full electrical wave length at 145.25 MC to fulfill two requirements. This length assures that the transmitter will be a minimum of a half wave away from the transmitter and also assists in reducing SWR resulting from the feeding of balanced loads with an unbalanced line at this frequency. If not satisfied with this arrangement, and some critical amateurs will not be, any random length of RG-59-U can be balanced at the antenna by the simple attachment of a quarter wave balun (13.5" long) of RG-59-U coax so that the shield only of the balun connects to the center conductor of the feed line at the antenna and to the shield of the feed line a quarter wave away. The drawing of the dipole shows such a balun attached. It can be used with all the antennas except the ground plane which is an unbalanced antenna requiring an impedance matching device.

Electrical and mechanical connections are made between quarter wave sections with short lengths of heavy stranded copper wire with brass fuse clips soldered to each end. Feed line connections to the driven elements are also made with fuse clips. Tuning stubs, spacers and half-elements for the cubical quad are made from ¼ inch tubing which has been tapped with a 10-24 thread. Fuse clips are attached to the ends by means of ⅜ inch 10-24 brass machine screws.



Two Element Beam

For the average user, all of the antennas will be found to operate quite satisfactorily without adjustment over the most used portion of the band (144.5-145.5 mc). The more discriminating amateur, however, will find that the versatility of the system is such that the antennas can be tuned to resonance at his favorite frequency by lengthening or shortening the quarter wave sections while closer impedance matches can be made by varying the distance of the parasitic elements from the driven elements on the beams or the quad. Now, on to the construction.

The Tinker Toy Two Meter Dipole

assembly time 1 min.

The dipole is the simplest antenna presented here and while usually assigned the relative gain figure of 1 has resulted in many fine QSO's over fairly long paths. It is assembled simply as shown in the picture and is ready to transceive in about a minute of elapsed time (while your filaments are warming up). Parts used are six of the Tinker Toy wheels, four pieces of ¼ inch dowling (for base), one 20 inch section of tubing (mast) and two 19 inch sections of tubing 180° apart in the top wheel. Clip on the feed line as near the wheel as possible and start communicating.

The Tinker Toy Two Meter Vertical Ground Plane

assembly time 2½ min.

Don't sell the ground plane short, particularly in locations where signals are predominantly vertically polarized or where a good earth or water pipe ground is not available. It establishes its own ground. The ground plane is the only antenna in the group which does not match RG-59-U directly at the base. In the parts list will be found a quarter wave matching transformer of RG-58-U coax and a shorted matching stub of RG-59-U coax. Either of these devices may be used effectively to raise the feed point impedance of the ground plane from about 30 ohms to 72 ohms.

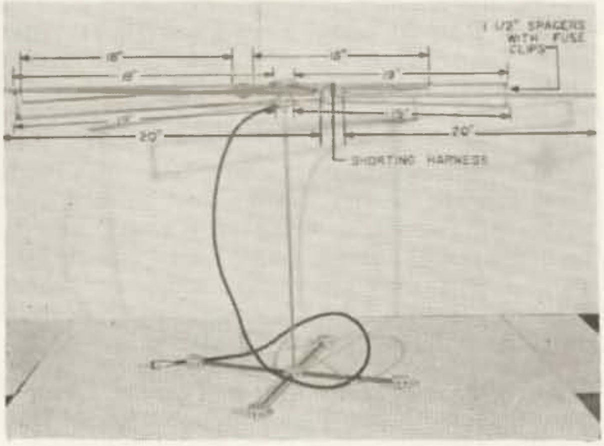
The quarter wave transformer is installed in series with the feed line while the shorted stub (in picture) is attached to the driven element, and the shield is connected to the ground planes which in turn are connected together with the shorting harnesses. The same base and mast described for the dipole are used for the ground plane. The vertical or driven element is 19 inches long while the four radials are 20 inches long and fanned out 90° from the vertical element. Many of you readers can think of a number of other methods for obtaining an impedance match with this antenna such as varying the number of radials or drooping the radials from their 90° angle. It should be evident by now how readily the

Tinker Toy system lends itself to experimentation.

The Tinker Toy Two Element Two Meter Beam

assembly time 2 min.

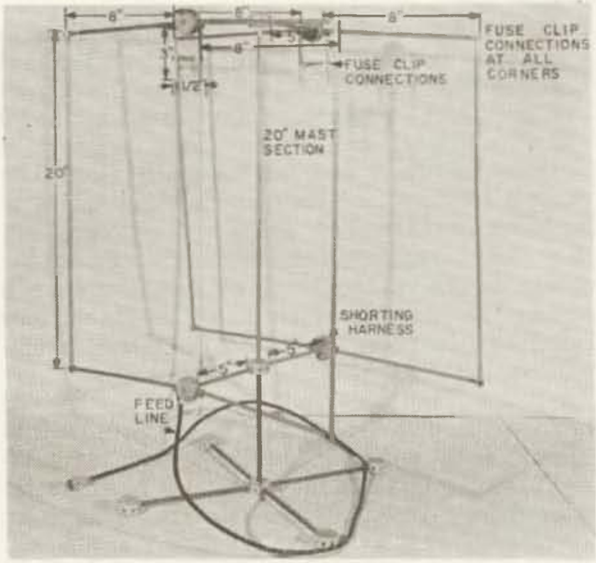
The addition of a 40" reflector (2-20 inch sections connected with a shorting harness) spaced .28 wave lengths away from the dipole antenna described earlier results in a two element beam maintaining the 72 ohm input impedance but giving a theoretical 4 DB gain over the simple dipole. Proper spacing is obtained by using the two 10½ inch segments of tubing along with part of the diameter of the center "wheel" and half the thickness of the end wheels. The front to back ratio of this antenna is only about 6 db, however so the desire for a little sharper antenna with higher gain led to:



The Tinker Toy Three Element Two Meter Beam

assembly time 4 min.

This antenna, slightly more complicated than those described previously utilizes a folded dipole to step up impedance, then two relatively close spaced parasitic elements to bring the impedance back down to approximately 75 ohms. The driven element is made by electrically and mechanically connecting four of the 18 inch elements and two of the 19 inch elements in a continuous loop configuration spaced 1½ inches apart and joined at the ends with the two 1½ inch clips described in the parts list. The over all element length should be 78 inches while the half wave configuration is 38 inches. The antenna is fed at the open ends of the two 19 inch segments as shown in the picture. Two 18 inch sections joined together and spaced 16 inches from the driven element give a parastic director while two 20 inch sections joined together and spaced 16 inches on the other side of the driven element as a reflector completes the antenna. The three elements should give a theoretical forward gain of 7.5 db which is believed to be just about the ultimate that can be achieved with the simple materials in the kit. (Want to bet someone makes a liar of me?)



The Tinker Toy Two Meter Quad

assembly time 8 min.

My own experience with Quad antennas on ten meters and on six meters led to the inclusion of this antenna on the list. It is a little more complicated to assemble and adjust but its low angle of radiation, 6 db forward gain and variable front to back ratio make it the ideal antenna for experimentation particularly when working with a table sized model where changes can be made quickly and conveniently. Its large signal capture area also makes it an ideal receiving antenna for weak signals. The quad has still further advantage in that it can be either horizontally or vertically polarized depending on choice of the feed point. The quad driven element is made by joining four 8 inch sections with fuse clips on the ends to each of two 20 inch sections (sides). The 8 inch sections are then joined together with a Tinker Toy wheel as shown in drawing. Three inch tuning stubs are then hung from the top by means of fuse clips and the element tuned to resonance at your frequency by sliding one of the shorting harnesses up and down the stub. The feed line is attached at the bottom wheel on either side of the insulation. The reflector is made in the same manner except that a shorting harness is clipped on across the lower Tinker Toy wheel. Three inch tuning stubs are attached with fuse clips across the top wheel as shown and the tuning stub adjusted so that this element is about two inches greater in over all length than the driven element. The front to back ratio may be adjusted by varying the length of this element. The two elements are joined together with two booms (top and bottom for extra rigidity) and spaced about 12 inches apart to give an input impedance of 72 ohms. Here again, impedance can be varied by lengthening or shortening the booms or merely by sliding the Tinker Toy wheels back and forth on the booms until a good match is obtained.

So there you have it, a kit which weighs less than three pounds and cost less than $5.00 and which can be fit readily into a briefcase or a corner of a suit case to go along with your Heath Twoer on these out of town business or pleasure trips.

It should be obvious by now that any number of arrays can be designed and built around the parts provided in this kit. At least two are included here which are not even described in the body of the text. The folded dipole incorporated in the three element beam can be used as a separate antenna fed with 72 ohm coax if a half wave (27 inch) impedance transforming balun of RG-59-U as described in the ARRL Hand Book is used. The driven element of the Quad is nothing more than a stretched out folded dipole, however, about 1 db gain is obtained from this configuration taken by itself. The input impedance is about 130 ohms, however, so a quarter wave Q section (two of the 19 inch elements) spaced 0.28 inches apart (center to center, .030″ between walls) can be used as a matching device.

I would be disappointed if in experimenting with this system someone did not come up with a brand new antenna design superior to anything presented here, in fact I hope to have some new configurations myself to try out on my next trip.

Think of some of the fantastic arrays we can come up with for 220 or 432! Anyone game to try? . . . K8LFI

Bibliography

ARRL **Radio Amateur's Handbook**—(American Radio Relay League, West Hartford, Connecticut).

Editors and Engineers **Radio Handbook**—(Editors and Engineers, Summerland, California).

Quad Antennas—William T. Orr (W6SAI).

Parts List

1—Set of Tinker Toys (98-cent size).
33 feet 1/4 inch diameter by .035 wall hard drawn aluminum tubing cut as follows:
7—20-inch lengths.
4—19-inch lengths.
4—18-inch lengths.
2—16-inch lengths.
2—10 1/2-inch lengths.
4—8-inch lengths tapped at one end with 10-24 thread and fuse clip attached with 3/8″ 10-24 brass machine screw.
4—3-inch lengths tapped as above.
2—1 1/4-inch lengths tapped both ends with 10-24 threads and fuse clips attached as above.
1—1 1/2-inch piece driven element spool spacer for 3 element beam.
2—1/2-inch lengths for connecting lead line to quarter wave transformer (if used).
1—quarter wave transformer—13.5 inches of RG-58-U ohm coax. Fuse clips soldered to center conductor and shield at both ends, or:
1—matching stub 5.7 inches of RG-59-U, fuse clips attached one end, other end shorted shield to center conductor.
1—quarter wave balun (optional) 13.5 inch piece of RG-59-U, fuse clip attached to shield only at one end, small alligator clip at other.
4—shorting harnesses. #12 or heavy stranded copper wire 2 inches long with fuse clips soldered to both ends.
1—feedline 54 inches long RG-59-U coax. Fuse clips attached to one end, coax connector or RCA type phone plug attached to other (for Heath Twoer).

For the mobile ham a long way from home or possibly a disaster area

Ready Made Emergency Antenna

R. E. Baird W7CSD
3740 Summers Lane
Klamath Falls, Oregon

In the ranks of hamdom the shunt fed vertical antenna is seldom mentioned. Some reference has been made to this oddity used for six meters and once in a while back in the days when we had a five meter band but to this writer's knowledge practically nothing has been done on the lower frequencies. When have you worked anyone on 75 meters using a shunt fed tower? Many hams would tell you that it is impossible. Yet the boys up in the broadcast band have been doing it for years. Much has been written about the virtues of the vertical ground plane antenna. A 75 meter quater wave series fed ground plane has been used quite widely by hams who could figure out how to get 60 feet of mast mounted on an insulator.

How about the shunt fed? A shunt fed vertical is any grounded vertical antenna, preferably a quarter wave length or higher, which is fed some distance off the ground. The base of the antenna is grounded to the earth. The more elaborate the ground system the better. Broadcast stations use 120 radials or more, usually at least a quarter wave length long. As is the case with the popular ground plane at least four radials would be a good idea although water systems many times have a pretty good contact with the ground. The method of feeding this type of antenna is shown in Fig. 1a. A simplified equivalent diagram is shown in Fig. 1b. Consider the tower (or vertical wire) to be an LC circuit which is not quite resonated. For most applications; that is, under a half wave high the circuit is inductive. By adding a capacitor between the tap point and the ground end the tower may be resonated. In the physical system the sloping lead and the capacitor form this part of the tapped circuit.

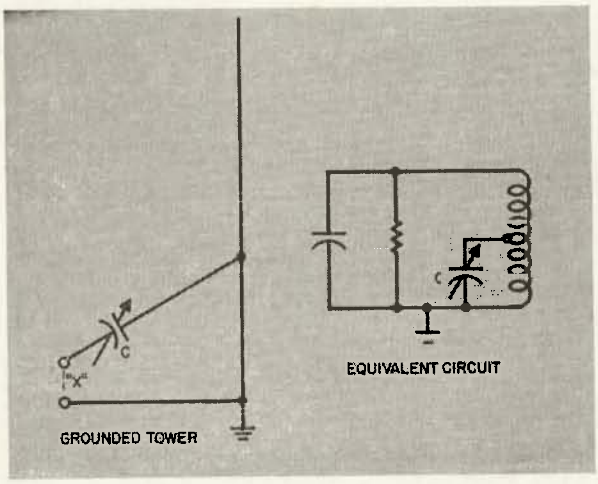
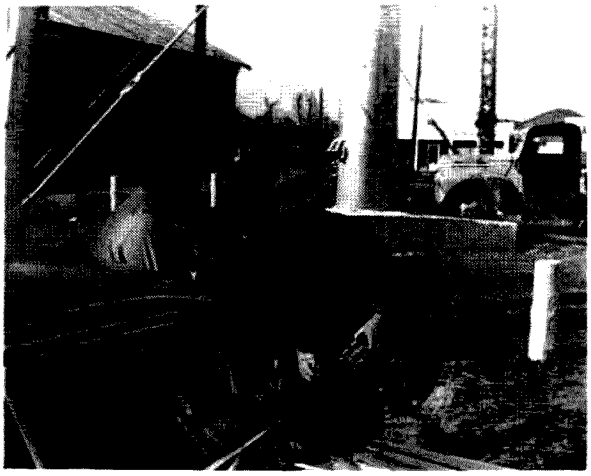


Fig. 1a and b

The impedance presented at point "x" is a function of the slope of the lead and the height of the tap point. It is possible by trial and error to find the exact impedance of any size co-ax line simply by moving the tap up and down the tower. A broadcast station with a 72 ohm line will tap the tower at the 72 ohm resistance point and resonate with the capacitor, thus eliminating impedance matching networks. The ham who has a high tower in the back yard (even with a hat full of beams on top) could do the same thing. An impedance bridge would be a must. *However*, if you feed the shunt fed tower *directly* from a transmitter that has a pi network in the

final, with the help of a series capacitor the network will work into most any reasonable sloping lead set up. The old style tank with a coupling coil will work equally well with a little adjustment of the pickup coil size and resonating with the series capacitor. Just as a random guess use a lead at approximately a 45° angle connected about one third of the way up the tower. A little trial and error on the series capacitor and the pi network will load the transmitter to the optimum value*

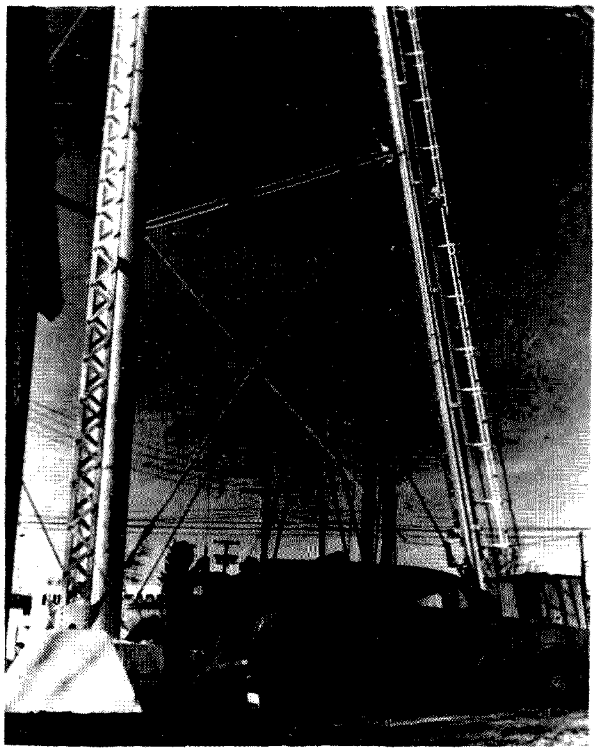
The above gives a little background on how this thing works and if you have a grounded tower in the back yard, give it a try. Most



folks don't have a high tower and its for sure a ham mobiling 200 or 300 miles from home doesn't have one. So where do you find a ready grown quarter wave or higher tower? If you are traveling in flat country its a cinch that any town you might drive through will have a steel water tower. It will be 60 feet high or higher, maybe 100. The ground system will be the whole city. So wheel up about 30 or 40 feet from the tower. Take a wire from transmitter ground to the base of the stand pipe and clip on with a large battery clip. Then take a lead in series with a 100 mmf variable capacitor and the hot side of the pi network, about 50 feet long, and climb up the ladder until you run out of wire and clip on to the ladder. Tune up the rig to the proper loading and you are in business.

Proof of the pudding

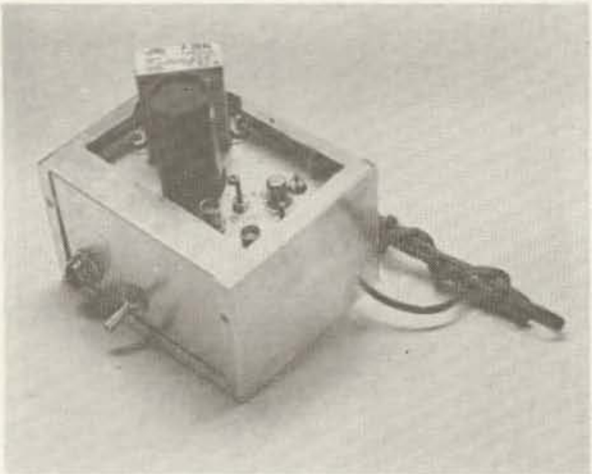
We took K7DDI's mobile to a high water tower in Merrill, Oregon to actually check out a shunt tower in the field. An Elmac 77 was used for the transmitter. This normally worked into a 9 foot center loaded whip. Measurements were made comparing the tower to the whip. In general the height of the tap was not critical. We first tried to load the Elmac without the use of the series capacitor. Loading was alright but when modulation was



applied things started arcing over. So we put in the capacitor to cancel out the inductive reactance of the tower and things worked fine after that. In our actual case the tower was about 100 feet high and we tapped in about 30 feet off the ground with the car 30 feet out from the tower, as can be seen in the accompanying photographs. *In all cases* the water tower was at least 3 "S" points better than the whip. Receivers, of course, differ but in Ft. Lewis, Washington 500 miles away we received a 10 db over 9 armchair copy with the water tower against an "S" 5 down in the mud report with the whip. From Eugene, Oregon, over 200 miles away the report was similar. From Klamath Falls, 15 miles away there was still 3 to 4 "S" points difference. Now if an "S" point is 6 db, as has been alleged by many manufacturers, this means our minimum report indicated an 18 db gain over the mobile whip antenna. To anyone who has ever designed a beam this is a fantastic amount of gain. We are a little skeptical, but one thing is for sure, a shunt fed water tower compared to a mobile whip antenna can make the difference between good intelligible copy and no copy at all.

We hope some ambitious mobiliers will experiment further with the shunt fed tower. A water tower has a ready made ground but presumably a grain elevator or any other metal structure with some height to it could be made to work. In case of a disaster area this would be a sure fire antenna to get some rf into the ether and start handling traffic in jig time. And the ham a few hundred miles from home can avail himself of a good antenna to get into home base for the cost of a hundred feet of connecting wire. . . . W7CSD

* It is quite likely that some mobile as well as larger transmitters will load without the use of the series capacitor and not experience any fireworks



Frank Bullock
191 Puritan Avenue
Forest Hills 75, New York

Two Meter Nuvistor Line Amplifier

AFTER playing with two meters for a while, and chewing the fat with all of the locals, the thought of a little DX may whet the appetite. Even with the addition of a good antenna or beam, the limiting factor is often the noise figure of the receiver. A good preamplifier will improve even the best commercially available receiver. The *Line Amplifier* is just that; a good low noise Nuvistor preamplifier.

With the advent of the Nuvistor, a new opening exists in the realm of low noise equipment in VHF and UHF. The Line Amplifier is capable of a 46 db overall gain, but in the interest of making the entire band flat, with a given noise figure over the band, we settled on an overall gain of twenty six db. This produced an overall noise figure of 2½ db, which is pretty good for a low cost preselector.

The major trouble with most pre-amplifiers is that the sheet metal parts are difficult to fabricate. We had a choice of several types of packages, but finally decided upon the Minibox type of construction with a sub-chassis. The sub-chassis must be of cadmium plated steel (such as a steel chassis plate), tin plate, copper or zinc plate, so that it can be soldered. Notice that no shielding is used. Because of the neutralization of the amplifier none was necessary, and no problems were encountered.

The line amplifier has its own ac power sup-

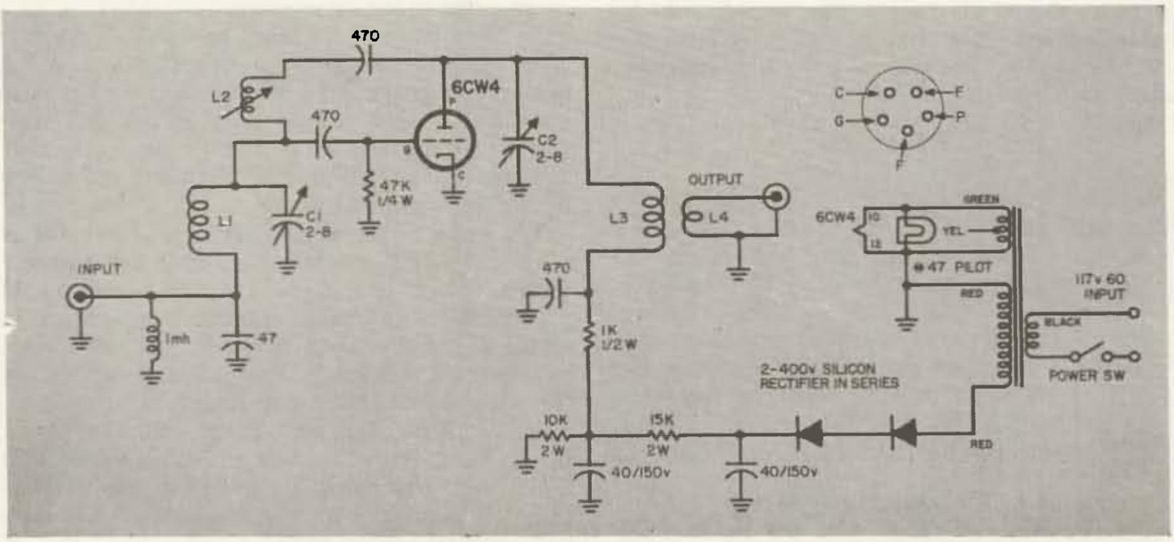


Fig. 1

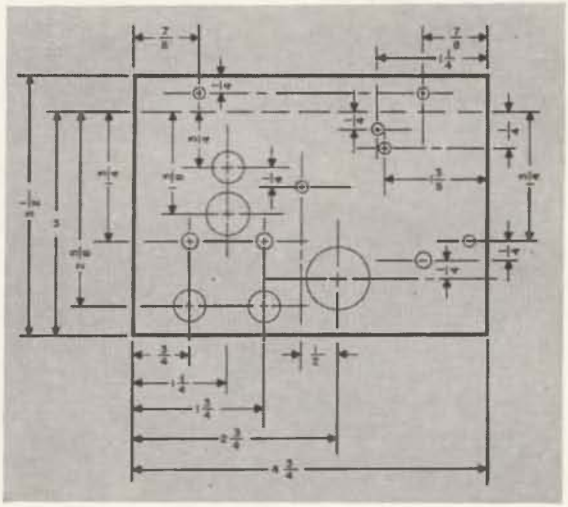


Fig. 2

ply built in and can therefore be connected to any receiver without having to get into the receiver circuitry. BNC type connectors were employed so that a small quick disconnect 50 ohm connector could be used. The total cost should be about fifteen dollars, using the best available commercial parts.

Construction

Construction of the line amplifier dictates that all leads be short and soldered with a hot clean iron. Whether it is a ground connection or to a tube socket, a clean solder connection is a must, since a cold solder joint can generate noise. Start by following the sub-chassis layout and drilling all holes with care. Locate all ground connections and pre-tin for easy soldering later. Mount all parts after mounting the Nuvistor socket, which is soldered into place. A word about the socket is important here. The socket should be mica-filled and not the standard black bakelite type socket. Since solder will flow very easily around the shell of the socket, which also acts as a shield, buy two just in case, and if solder should get into the inner shell part, discard the socket. You'll find your time is worth a lot more than the twenty five cents the socket cost. All wiring is point-to-point, especially in the vicinity of the socket.

The self-supported coils (L1 and L3) are mounted last. L4 is constructed by placing two turns of number thirty wire over the B-plus end of L3. The loose ends of L4 are secured through a ¾ inch long piece of spaghetti tubing slid up against the coil body

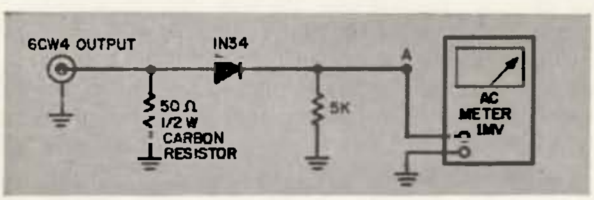


Fig. 3

Letter

John K6BJ and XYL

Ed:

I dropped in on John Reinartz, K6BJ, and Mrs. Reinartz at their super-nifty double-width modern trailer type retirement home near Santa Cruz. I caught them just as they were starting out for the beach and an afternoon of clam hunting.

John was just on the verge of sending us an article of a little frequency deviation meter he developed which measures very accurately plus or minus 500 cycles of desired carrier frequency, and operates directly from the headphone output of the receiver. Very handy for net operation or at any time you want an immediate visual check on deviation of a received signal from "target" frequency. Parts cost less than $10, easily built. The one shown in the photo with John is built in a surplus meter case with a few acres of space to spare. **Jim WA6EXU**

The article is in Jim and being prepared for publication. It sure is good to see John getting back into print again!

and cemented in place with either "Q-Dope" or Duco cement. Wait until the entire assembly is dry before mounting and keep the iron away from the coil body. Solder the ends of L4 right at the BNC, keeping leads of L4 as short as possible.

Initial Testing

Once assembly is completed the Line Amplifier should be plugged in and turned on. Measure the voltage at "A," where the filter resistors, bleeder and B-plus points meet. The exact voltage is not critical, but should not exceed fifty volts. A lower voltage may actually give a better noise figure. The alignment procedure requires a good signal generator and a grid dipper. The signal generator is important, since the noise figure is dependent upon good alignment. Unfortunately, we have been unable to find a different procedure using just a grid dipper that will do the job.

Alignment Procedure

Start the alignment by turning off all power and with the aid of a grid dipper, set L1 and L3 to 146 mc, using C1 and C2. Connect the signal generator (which should have a 50 ohm output) to the input of the line amplifier.

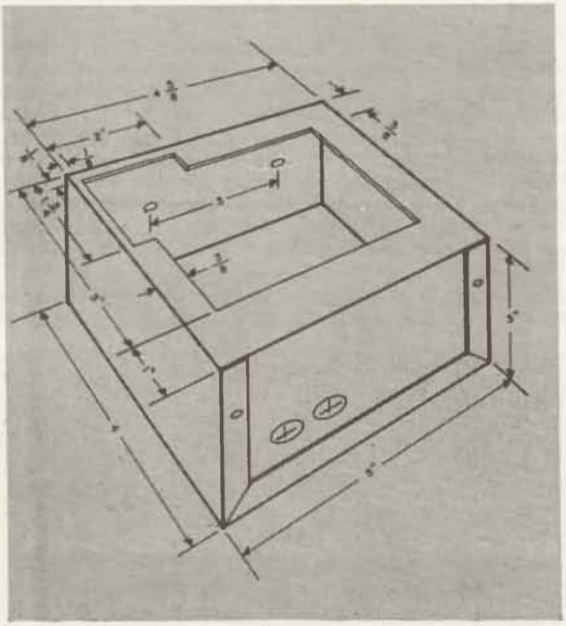


Fig. 4

Connect the output meter circuit shown in Fig. 3 to the line amplifier output.

With the signal generator power off, but connected so as to terminate the input, adjust L2 until *no* dc appears at the output point "A," making use of any 1 volt, 1000 ohm (or better) per volt meter. It may be necessary to add or subtract turns from L2 if this point cannot be found with the iron core adjustment. The layout determines the exact size of L2.

Turn the signal generator power on and set

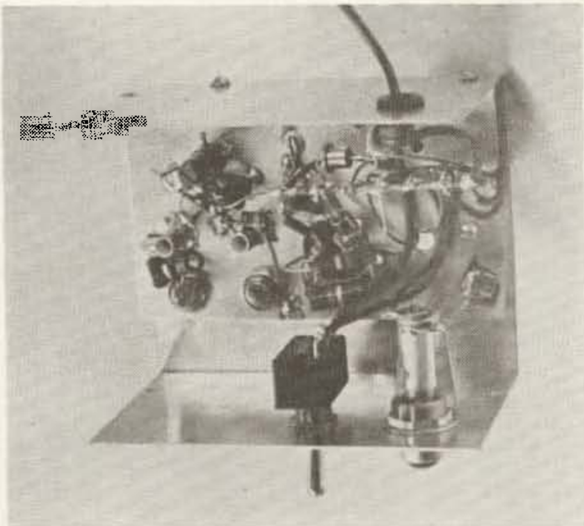


Fig. 5

it for about 30% modulation and 146 mc. Adjust C1 and C2 for maximum output on the 1 millivolt ac meter. Don't feed more signal in than is necessary to provide ½ millivolt of recovered audio. If your signal generator has a good well calibrated attenuator, check to see if the gain is constant over the band. It should be within 1½ db at either end (144 to 148 mc). With the signal generator removed there should be no tendency to oscillate, as would be indicated by any dc at point A, Fig. 3. Should dc be present, it would be necessary to readjust L2 as before and realign at 146 mc.

The line amplifier is designed to work into fifty ohm antenna systems and into a fifty ohm receiver. Any deviation from this would necessarily require minor changes.

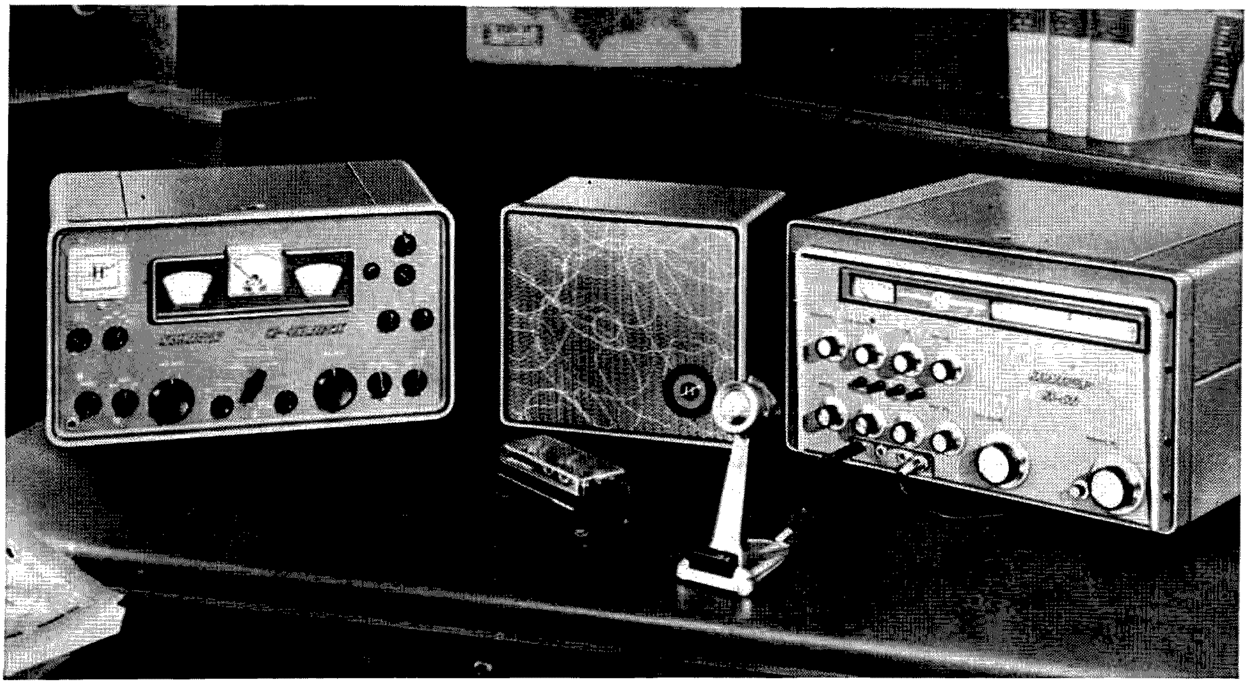
Coil Data

L1—5 Turns #18 close wound on 3/16" dia. form. Use enam. wire. Remove form.
L2—14 Turns #22 close wound on ¼" iron core tuned coil form. Use enam. wire. (CTC-LS-6 with white slug).
L3—6½ Turns #18 close wound on 3/16" dia. form. Use enam. wire and remove form.
L4—2 Turns #30 wire. Wind over B+ end of L3. Use enam. wire and fasten with Duco.
C1, C2—Tubular type trimmers (Erie).

Club Subscriptions

As announced a few months ago, clubs may send in group subscriptions at the rate of $2.50 per one year subscription in groups of five or more subscriptions. These subs must start with the next published issue and be for just one year. Orders for back issues should be sent in separately. By simplifying the procedure we can offer this reduced rate.

The regular subscription rate is $3 per year; $5 for two years; $4 per year for DX operators outside North America. All back issues are 50¢ each. Send your name, call and address to 73 magazine, 1379 E. 15th St., Brooklyn 30, New York. Include money.



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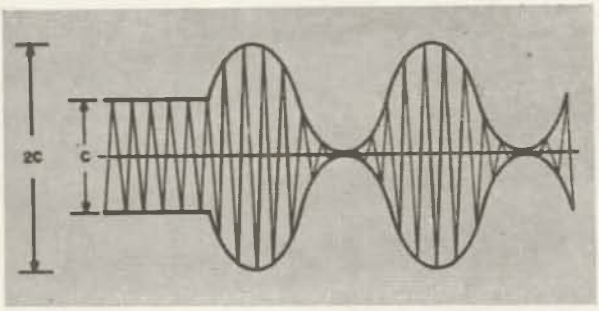

A Review of

AM Modulation Systems

With Special Reference to an Oldie

R. E. Baird W7CSD
3740 Summers Lane
Klamath Falls, Oregon

Most people are acquainted with the standard diagram for the linear wave form pattern of 100% modulate AM. To refresh your memory observe Fig. 1. If the amplitude of the carrier is C the amplitude of the positive peak at 100% modulation must be 2C. The negative peak must be zero. Let us consider Fig. 1 to be the pattern formed on an oscilloscope connected with the vertical deflection plates tied to the output of the modulated amplifier; thus, it would be a voltage wave form. Since an antenna (or dummy load) is a fixed impedance, if the voltage doubles on the positive modulation peak the current must also double. This means that the modulated amplifier must deliver four times the carrier power on the 100% positive modulation peaks. Regardless of the method of modulation this is an *absolute* requirement of an amplitude modulation system.

The purpose of this article is to show how this requirement is satisfied by several methods of modulation and to show the advantage of one of the easier methods.

Plate Modulation

Plate modulation (or plate and screen modulation if the modulated stage happens to be a tetrode or pentode) is probably more used than any other system of amplitude modulation. There may be some economic arguments for plate modulation but ease of operation would perhaps be the leading argument. It is comparatively easy to get good modulation under just about any set of bad conditions you can think of. Within limits the excitation to the modulated stage may be varied widely. The loading can vary from light to very heavy with or without reactive components and the proper wave shape will still be maintained. A wide range of plate voltage will only affect the carrier power and the efficiency can be maintained at a rather high percentage.

The common system used at the present is some form of audio amplifier, usually class B push pull, transformer coupled to the modulated amplifier as in Fig. 2.

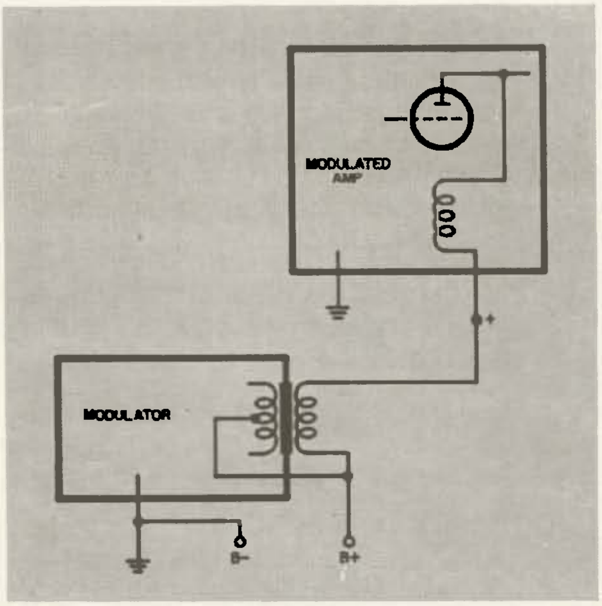

Fig. 2

A mathematical example will serve as an easy explanation of plate modulation. Assume the modulated amplifier in Fig. 2 has an unmodulated input of 500 volts and 100 ma and is adjusted for normal high efficiency output. From the power input standpoint this looks like a fixed resistance load of 500 volts divided by .1 amps, or 5000 ohms. On the 100% negative peak of modulation the voltage in the secondary of the modulation transformer is exactly equal to 500 volts peak and is in series opposition to the 500 volt dc supply; thus, voltage on the modulated stage is zero and

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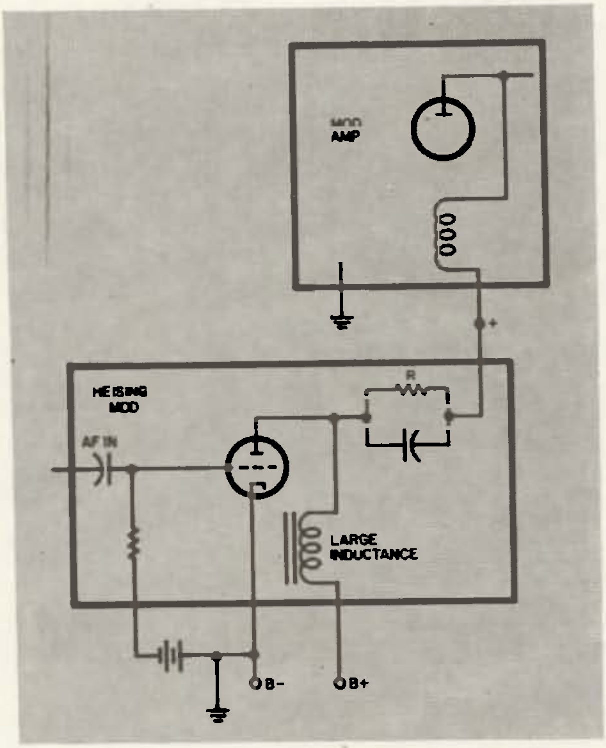


Fig. 3

power is zero. On the 100% positive modulation peak the voltage in the secondary of the modulation transformer is exactly equal to 500 volts peak and is in the series aiding direction with respect to the 500 volt dc supply; thus, the voltage on the modulated stage is 1000 volts. Since the modulated stage still looks like 5000 ohms the current will be 1000 divided by 5000 or .2 amps. The voltage has been doubled and the current has been doubled; therefore, the power input is four times the unmodulated value. Nothing has been done to change the efficiency; so by the same token, the power output is four times the unmodulated value.

The foregoing is easy to follow and will readily be understood by anyone with an elementary knowledge of Ohm's law.

In order to complete the plate modulation picture Heising modulation should also be mentioned. The effect on the final amplifier is identical to the above. Heising uses a single tube (or parallel tubes) in class A and is connected as per Fig. 3. In order to get a full the rf tube and usually a dropping resistor R with a large by-pass capacitor across it (to allow the ac modulation to get through) is incorporated. This circuit is practical only in low power applications.

Series modulation also does the same thing. In this case the modulator acts as a series variable resistor which varies at audio frequency. It reaches plate current cut off on the negative peaks of modulation and allows the voltage applied to the modulated stage to double on the positive peaks. Because of inherent losses in the tube the power supply must have more than twice the rated voltage of the modulated stage. For example, using the foregoing mathematical problem, the power supply would probably need to have 1200 volts. 500 volts would be across the modulated stage and 700 across the series modulator in the unmodulated condition. This method is not too practical for reasons of the high voltage necessary and the fact that the modulator tube must have high dissipation properties, in the case noted 70 watts.

The three different systems noted are all systems of getting plate modulation. To get plate and screen modulation in the case of a tetrode or pentode all that is needed is a series dropping resistor from the screen to the B+ lead of the modulated amplifier. The theory is still the same.

Efficiency Modulation Systems in General

Nearly all systems of AM modulation other than plate modulation involve variable efficiency. Grid, screen grid, suppressor grid, and the use of a class B linear all involve applying modulation to some other element than

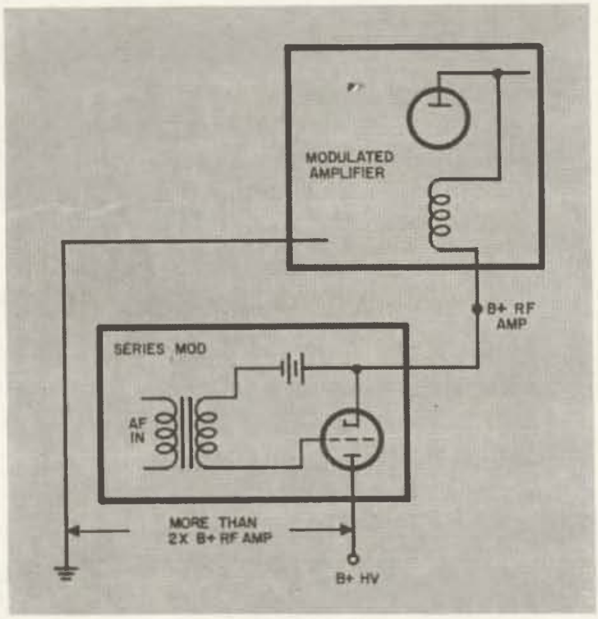


Fig. 4

the plate in such a manner that on negative modulation peaks the plate current is cut off; hence, the power will be zero. On the positive peak the plate current is driven to double the unmodulated value. This alone will supply twice the unmodulated power. Something else must double in order to get four times the power. The only other variable is the efficiency. If the unmodulated efficiency is 30% it is comparatively easy to double the efficiency in a nearly linear manner to get the necessary 100% peak. If the unmodulated efficiency is 35% it is still very possible. If the unmodulated efficiency is 40% or over, the positive peaks will probably start flattering unless all adjustments are right on the nose. For ex-

ample, suppose we are all tuned up to 80% efficiency with no modulation. It becomes obvious that this will be a little hard to double. They don't hardly make 'em that way any more, 160% efficient that is. Soooo what do we do? There is only one way out. We deliberately louse up our efficiency. This really hurts and is probably the outstanding objection to methods other than plate modulation. The redeeming feature of course is that only a small amount of audio power is required.

A Simplified Version of What Actually Happens

For purposes of illustration let us consider the battery shown in Fig. 5a. This battery has an internal resistance of 10 ohms. The fixed external load is 5 ohms. A quick Ohm's law calculation reveals a current of 1 amp, a total power delivered of 15 watts and only 5 watts delivered to the load.

In Fig. 5b the battery has been replaced with a battery having only 2.5 ohms internal resistance. Now we have 2 amps, a total of 30 watts, and 20 watts delivered to the load. *Note*, this is four times the power delivered to the load in 5a. The efficiency has doubled, going from 33% in 5a to 66% in case 5b. The voltage generated remained the same.

The vacuum tube modulated amplifier is not unlike the battery. As far as the load is concerned, the vacuum tube is a voltage generator with an internal resistance. As the modulating voltage is applied the internal resistance of the generator changes. Actually this is an over simplification as the generated voltage changes some too and in the right direction. But essentially it is necessary to lower the efficiency to something on the order of 33% unmodulated in order to get the linear modulation we want. The internal resistance of the generator is increased by changing the dc bias on the element to which modulating voltage is to be applied or coupling back an overload, that is to say a low value of ^{R}load, to the plate of the tube may give the right ratio of ^{R}load to ^{R}internal, or a combination of both will bring the efficiency down. In certain cases, the

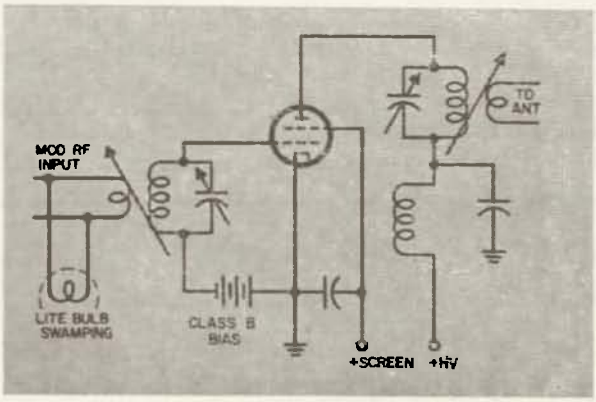


Fig. 6

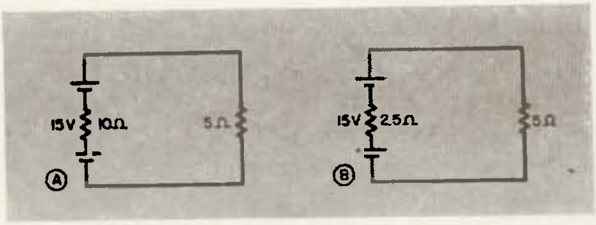


Fig. 5

class B linear for example, the excitation must be greatly reduced.

Some Variable Efficiency Modulation Systems

Class B linear: This is not really a system of modulation, but has many of the attributes of efficiency modulation. The rf input to the class B linear is already fully modulated. However the input impedance of the Class B linear is anything *but* linear. During the negative peak the grid draws no curernt at all; whereas, on the positive peak the grid draws considerable current. So the load to the preceding stage varies from practically nothing to fairly heavy in different parts of the modulation cycle. In order to minimize this non-linear load it is necessary to put an artificial load in parallel to "swamp" the modulated signal. This can be a non-inductive resistance or even a light bulb hung across the link coupling. Having hung the swamping load, voltage regulation from the modulated exciter will be good. By reducing the excitation to a low value and by carefully adjusting the coupling of the antenna system, definitely on the too close coupling side, (or too wide open a loading capacitor in a pi network) very linear output may be achieved. A variable dc bias is highly desirable. Grid leak bias is out!!

In order to not exceed plate dissipation ratings of the tube, power input cannot exceed 150% of rating because efficiency will be on the order of 35%. Higher efficiency will result in flat positive peaks. A conventional circuit is shown in Fig. 6.

Control Grid Modulation

All of the requirements for control grid modulation are same as for the Class B linear except that the bias may be for class C. The modulating voltage is applied in series with the grid bias. Again a combination of overloading and excitation adjustment to get the efficiency down so that it will vary linearly must be followed. A close study will reveal that grid modulation and class B linears are very much the same. A conventional circuit is shown in Fig. 7.

Cathode Modulation

Cathode modulation, as shown in Fig. 8, is merely a combination of grid modulation and

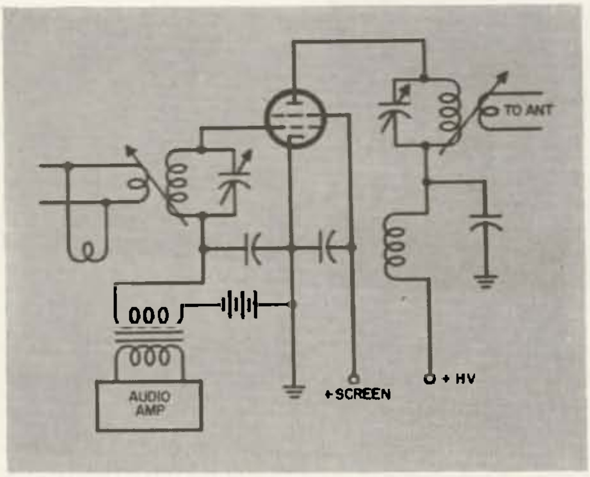


Fig. 7

plate modulation. Consider for a moment the effect of having the grid connected above the modulation transformer. In this case we have ordinary plate modulation except the transformer is connected on the cathode side of the amplifier. Since it is a series circuit it would make no difference on which side the transformer is connected. Suppose for an instant that we have sufficient audio to plate modulate 20%. If we now advance the grid down the adjustable resistor tied across the modulation transformer we get additional grid modulation. If adjustments are carried out as outlined in grid modulation we can get the additional 80%, making a total of 100%. In this case, due to the presence of some plate modulation we will not have to double the efficiency. So we can run at a higher unmodulated efficiency. Depending on the amount of audio power available, the efficiency may run up to

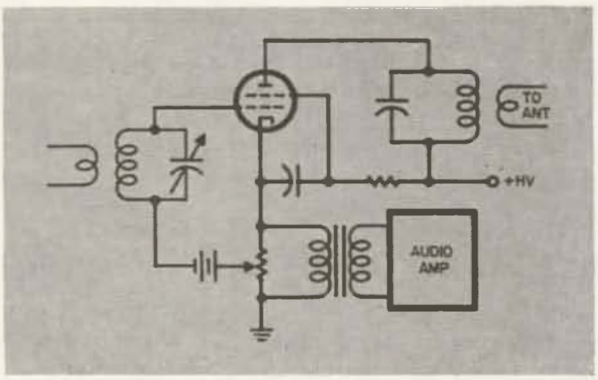


Fig. 8

50% or so. This is an expedient that may be used when one has a public address system, or similar piece of gear, having insufficient power to plate modulate the final amplifier.

Screen Grid Modulation

There are assorted forms of screen modulation but they all hinge on lowering screen voltage, in some cases into the negative region, and adjusting for the proper coupling to get linear performance. Many screen grid type tubes are not capable of 100% screen modulation. Some specially built tubes do a very good job, particularly on speech. In general it is difficult to get a distortion free scope pattern on a pure tone; however speech may be quite acceptable. In many cases, judging from what this observer hears on the air, the positive and negative peaks are badly unbalanced and considerable flattering occurs on the positive peaks. This is probably the result of adjustment without the use of a scope. This particular form of modulation has become popular in controlled carrier systems of which there are too many for the scope of this article. They all trade on running with very little output and plate dissipation with no modulation. When modulation is applied input, output, and plate dissipation go up. With a sustained sine wave of modulation many of these circuits would have plate dissipation far exceeding manufacturers ratings. But with speech, ratings are only exceed momentarily. Fig. 9 is a conventional circuit. Quite an article could be written on variations of screen modulation.

Suppressor Grid Modulation

This form of efficiency modulation was very popular back in the 30's, but is almost unknown today. Yet it is perhaps the easiest of all the systems of this kind to adjust for linear operation. Its chief claim to fame is the

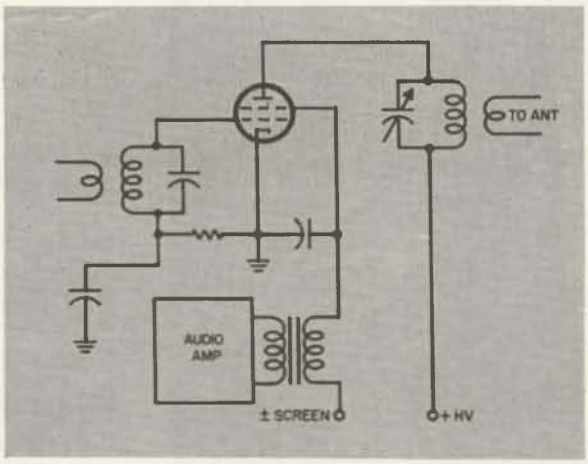


Fig. 9

relative unimportance of the loading. Almost all of the variable efficiency is derived from adjustment of the suppressor grid voltage. If you are not concerned with efficiency it is possible to get linear modulation at any value of load whatever just by reducing (making more negative) the dc potential on the suppressor grid to the necessary level. In practice the optimum loading for an unmodulated signal will not have to be changed. Just bias the suppressor grid sufficiently negative to get a linear pattern by observation. This usually requires a modulating voltage that never drives the suppressor into the positive region; hence, little or no audio power is required. As is the

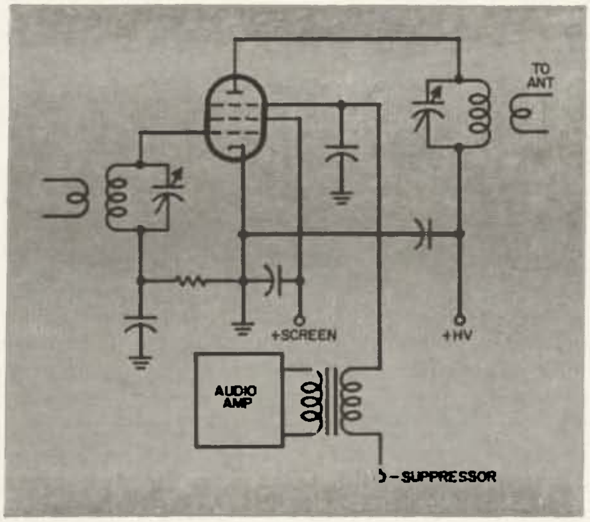


Fig. 10

case with most efficiency modulated systems, more power out, well modulated, can be obtained with high plate voltage. A conventional circuit is shown in Fig. 10.

Transmitting type pentodes are a scarce article on the modern market. The 4E27 and 4E27A are a good example in the 100 watt plate dissipation region. The 803, although a little on the obsolete side, is excellent and readily available on the surplus market. The WE-312A (also with Navy number CW-38412) in the 50 watt size is one of the best pentodes for suppressor modulation ever built. And of course in the low power bracket we have the 837 and the 802. The GF-11 GI transmitter, which is familiar to many, uses 837's. The BC-1306 uses a 2E22 suppressor modulated. The BC-325B uses a pair of 803's with about 2500 volts on the plates. There were several other military transmitters using suppressor grid modulation.

It is hoped that this review of AM modulation systems will bring the old timers up to date and show the younger ones what they are getting into. If you have access to a high voltage supply and do not have any high power audio available buy a couple surplus 803's and give supressor grid modulation a whirl.

Letters

Dear Wayne:

You seem to know all about everything, perhaps you can explain something that has been bothering me for a long time. How come the WΦ calls have a zero with a line through it instead of a plain zero?

Wretched Coward K2PMM

Good Heavens, I thought everyone knew the answer to that! Originally the country was divided into nine call areas. Unfortunately the Ninth Zone was much too large and it filled up quickly. The obvious answer was to add a Tenth Zone. This was done. International regulations did not permit the FCC to issue W10 call letters, so they had to put the one on top of the zero, making one single number out of it. This number is a ten, not a zero, and should be read as a ten. Any knowing ham gets a laugh out of the lids who go on the air and call themselves W-zero instead of W-ten, as they should.

Globular Calculations

G. T. Martin, Jr. K5RPB
3296 Sandefer Street
Abilene, Texas

An amateur radio operator interested in exact alignment of a high gain antenna to better than one degree of arc will also find a use for the mathematical method of calculating exact true bearing and distance to a remote location from his own position. Although the solutions appear formidable, ten minutes of effort will eliminate guessing the right direction to point your beam for that elusive rare DX.

If you own a large globe, the use of thread and a protractor will give you reasonably accurate bearings. By typing one end of the thread to a pin placed at your position on the globe, and stretching the thread across the point on the globe you wish to contact, you can determine a true bearing by measuring the angle between the lay of the thread and a meridian at the midpoint of the thread. The distance may be roughly measured by laying the length of thread along any meridian and multiplying by 60 the degrees of latitude subtended. One minuts of arc is equal to one nautical mile. The degree of accuracy is dependent upon the size of the globe, the accuracy of the plotted information, and for distance, how you stretch the thread. Unfortunately, not all of us have globes, and must resort to other methods.

Another way to find true bearings to distant points is by using great circle charts, which are available from several sources. Most of these assume all of us live in New York City, San Francisco, or Kansas, and are subject to error if used from some other location. For short distance, aeronautical charts (polyconic projection) are reasonably accurate. Mercator charts, those which portray the earth as flat, with latitude and longitude at right angles, are unreliable for determining bearings.

The most accurate method of finding azimuth and distance of a point from your location is to solve for the great circle path between these two points by using spherical trigonometry. A great circle path is the shortest distance between two points on a sphere. It is not necessary to understand how the formulae are derived in order to obtain the required information. The proper answer is dependent only upon correct computation. You must know the geographic coordinates of both your transmitter and the receiver you wish to contact, and have access to tables of trigonometric functions. Usable angles of latitude and longitude may be obtained from any available charts, gazetteers, or publications. The necessary tables can be found in most engineering handbooks, professional references, or your old textbooks. In any event, everything you need is at your public library if you don't have the information in your shack.

For example, assume you are at Dyess Air Force Base, Texas 32°26'N-99°51'W, and desire a base azimuth for a rhombic pointed toward March Air Force Base, California 33°53'N-117°15'W. By substitution of values in the given formulae, you will find the correct true bearing is 280°. The distance is approximately 880 nautical miles.

Where Lx is transmitter latitude
Lr is receiver latitude
$\triangle Lo$ is difference in longitude
D is distance between sites (expressed as an arc)
Zn is true bearing East or West of North
then $(\text{Sin } Lx)(\text{Sin } Lr) + (\text{Cos } Lx)(\text{Cos } Lr)(\text{Cos } \triangle Lo) = \text{Cos } D$
and $(\text{Cos } Lr)(\text{Csc } D)(\text{Sin } \triangle Lo) = \text{Sin } Zn$

In illustrating this solution, logarithms are used for convenience in computation because tables were available. Simple tables of functions to the nearest 10' of arc, or a slide rule, will give an acceptable degree of accuracy. Multiplication of functions will take a little longer without the use of logarithms.

$\text{Sin } 32°26' \cdot \text{Sin } 33°53' + \text{Cos } 32°26' \cdot \text{Cos } 33°53' \cdot \text{Cos } 17°24' = \text{Cos } D$

log Sin 32°26' = 9.72942
log Sin 33°53' = 9.74625
9.47567 = .29900
log Cos 32°26' = 9.92635
log Cos 33°53' = 9.91917
log Cos 17°24' = 9.97966
9.82518 = .66861
.96761 = Cos 14°37'20"

D = 60 • 14 + 37⅓ = 877⅓ nautical miles

$\text{Cos } 33°53' \cdot \text{Csc } 14°37' \cdot \text{Sin } 17°24' = \text{Sin } Zn$

log Cos 35°53' = 9.91917
log Csc 14°37' = 10.59800
log Sin 17°24' = 9.47573
9.99290 = .98379 = Sin 79°40'

359°60'
79°40'
280°20' True Azimuth

Since March AFB is obviously west of north from Dyess FB, subtract 79°40' from 360° to determine true bearing, 280°. Measuring

true bearing and distance on a Lambert Conformal Conic projection of the United States (USAF GNC Series) gave Zn 275°, distance 890 nautical miles.

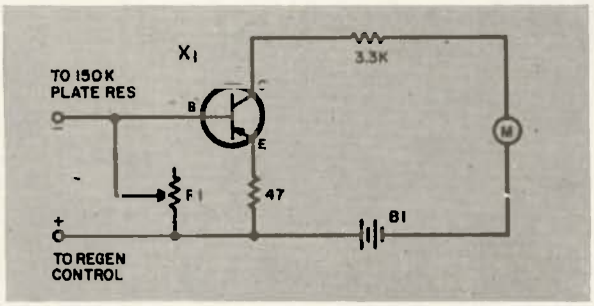
For those interested in the origin of this solution; it is common to the practice of celestial navigation. The astronomical triangle determined by the observer's assumed zenith, the observed body, and the north celestial pole is assumed to be on the surface of the earth. With the introduction of an auxiliary right angle, the unknown true position of the observer is determined from the known true azimuth and altitude of the body. Range and bearing from one point to another on the earth's surface is simply a different solution of the astronomical triangle. Now, point your beam in the right direction, and good luck.

73

Refer to: American Practical Navigator, H.O. No. 9.
Antenna Systems, AF Manual 52-19.
Handbook of Electronic Tables and Formulas, Howard Sams.

A S Meter For Your Sixer

Alan Bierbaum, K5VMC
332 Atkins Avenue
Shreveport, Louisiana



Due to the increased activity of six meter hidden transmitter hunts and the influx of the popular Heathkit "Sixer," an "S" meter circuit was developed at K5VMC/M to allow the use of a "Sixer" on local hunts. The circuit is applicable to the "Tenner" and "Twoer" as well.

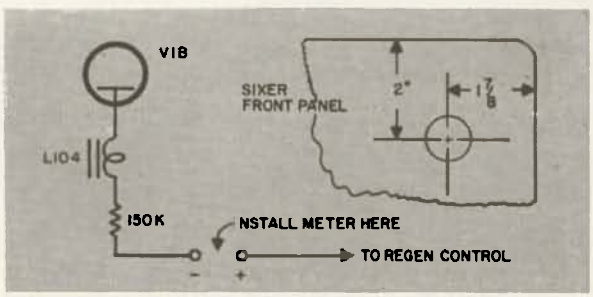
The unit consists of an inexpensive 0-1 ma. meter and a single transistor meter amplifier. Half scale deflection is obtained on a signal strong enough to quiet the background hiss as compared to approximately one fourth to one third scale on a 20,000 ohms per volt meter or a VTVM reading the voltage drop across the plate dropping resistor.

When the detector is operating under no signal conditions, it draws less than one mil. A strong signal causes the detector to draw just slightly more. Measurement of the voltage drop across the 150K plate dropping resistor produced approximately a seven volt drop which was not enough to give an accurate indication. A transistorized meter amplifier was built that would give 100 microamp sensitivity to a 0-1 ma. meter. The input was shunted to give approximately full scale reading with no signal. Application of a weak signal produced about half scale deflection which proved to be ample for hunts as well as relative indications in a fixed station use.

In operation, the meter functions as a transistor volt meter which measures the voltage drop across the input shunt. The shunt is adjusted so that the meter pointer just begins to deflect downscale with no signal input. This is the most sensitive setting and will give the best results.

The meter circuit here was built into a minibox just large enough to accommodate the meter on one end. A socket was used for the transistor but the leads can be soldered if extreme care is used to keep any heat from reaching the transistor. No special layout is necessary and lead lengths are not critical. The only precaution will be that the leads from the "Sixer" to the "S" meter should be hooked exactly as shown and that battery polarity is exactly as shown; otherwise the transistor will be damaged. To dress up the appearance a miniature imported "S" meter was used but any 0-1 ma. meter will work just as well.

In the HW-29 and the new HW-29A, the unit may be mounted permanently as shown in Fig. 2. The old HW-29 with the 8 mc modification kit can incorporate the "S" meter circuitry by installing two banana jacks on the rear apron and using an insulated shorting bar when the "S" meter is not in use. The meter in no way affects operation of the unit.



Using a conventional electrostatically shielded loop, a deflection of one tenth mil was obtained fifty feet from a sixty watt transmitter and a three tenth mil deflection at six miles from a twenty watt transmitter.

One meter, one transistor, three resistors, a battery, and you have an "S" meter which will give better fluctuation indication than the meter on the Gonset Communicator III.

Happy hunting! . . . K5VMC

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Baltimore 29, Maryland

VLF 1961

VLF—very low frequency—is identified[1] by the FCC as that part of the radio frequency spectrum between 10 and 30 kilocycles per second. In the early 1920's these frequencies were crawling with transoceanic commercial circuits which have long since been abandoned in favor of more profitable channels in the HF region. Nevertheless, this band is far from dead.

The U. S. Navy has found VLF signals ideal for reaching submerged submarines and now operates a number of powerful stations in this frequency range including the "mega-watters" NPG at Jim Creek, Washington and NAA[2] at Cutler, Maine. These two stations, along with NSS at Annapolis, Maryland and NPM at Pearl Harbor, transmit weather, press and traffic at good code-practice speeds. When things get dull, they while away the time sending "v's" in the time-honored manner of long wave stations.

The National Bureau of Standards has determined[3] that the transmission error in standard frequency broadcasts is much less at VLF than at higher frequencies because multiple reflections from the ionosphere do not take place. As a part of a program[4] to establish a uniform system of time and frequency broadcasts of high accuracy, station NBA in the Canal Zone sends one second dashes on a nominal frequency of 18 kc (offset —150 parts in 10^{10}) with the frequency maintained to an accuracy approaching one part in 10^{10}.

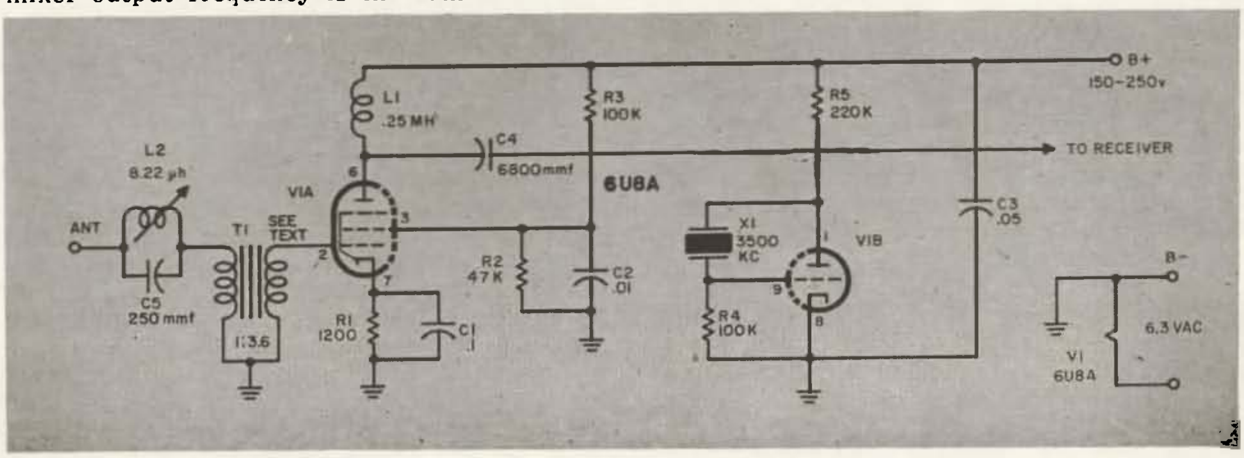
Converter for VLF

You can build a very simple converter that will bring VLF signals into your regular amateur-band receiver. No additional tuning controls are used. This device is similar in principle to the more familiar crystal-controlled VHF converter except that the selected mixer output frequency is the sum of the input and local oscillator frequencies instead of the difference of these frequencies.

The schematic diagram shows a converter which consists of an input filter, a fixed local oscillator and a mixer. A 6U8-A is used for the mixer and local oscillator. The oscillator is crystal controlled for convenience and simplicity. It is important to keep the oscillator level as low as possible so as not to block the receiver, which must tune to within 15 kc of the oscillator frequency. If a 3500 kc crystal is used, the combination will be automatically self-calibrating. For instance, a 20 kc signal will appear at 3520 kc on the receiver dial. Of course, any old crystal in the receiver's range can be used at no sacrifice in performance except the loss of calibration.

Component values are shown on the schematic diagram. T1 is a ⅓.6 vertical blocking oscillator transformer from a discarded Emerson TV set. The transformer is marked "B 12 M 18241 606" and peaks nicely in the 10 to 30 kc range. The 3500 kc crystal came from a BC-696 command transmitter. The trap, L2 C5, may be omitted, but it helps a lot if you have strong amateur signals or harmonics from TV set oscillators in the receiver band. L2 has 27 turns on a ½" diameter slug-tuned form using No. 30 enamelled wire.

The arrangement of components is not at all critical. A coffee can cover will make a good "breadboard" if you want to give the circuit a quick try. The unit shown in the photograph was constructed on a 4" x 2¼" x 2¼" Minibox and is provided with a cable and octal plug which connects with the accessory socket of an NC-300 receiver. The output jack is a BNC fitting. Use a short piece of coaxial cable between the converter and the receiver input terminals. Minimize pick-up of *if* signals by keeping this connection well shielded.



Receiver

The performance of this converter depends to a large extent on the receiver use with it. For best results the receiver should be as selective as possible and have good bandspread. Remember, the VLF stations are only separated by a kilocycle or so. Use a peaked audio stage or a Q-multiplier, if you have either, to make tuning easier.

When you are ready to try the converter for the first time, connect it to a source of filament and plate power and connect the output cable to the antenna and ground terminals of your receiver. Tune the receiver to the crystal frequency of 3500 kc and make sure the local oscillator is working. There should be a strong CW signal at 3500 kc which stops when you pull out the crystal. Connect the largest antenna you have to the converter input and tune carefully between 3510 and 3550 kcs for CW signals from the VLF station nearest you.

Some 80 meter CW signals may get through the converter too. Pick out one of these and adjust the trap inductance, L2, for a minimum signal. Adjustment of the trap should have no effect on VLF signals. After you have identified one or two of the loud VLF signals and adjusted the trap, tune carefully between 3510 and 3530 kc for some of the weaker stations. The converter has reasonable sensitivity in the LF band also. If your input transformer does not cut off too sharply and you are not too far from NSS, their transmitters on 64, 88, 122 and 150 kc may also be heard. The following table lists the VLF stations heard on this converter in Baltimore in 1961, together with their approximate frequencies.

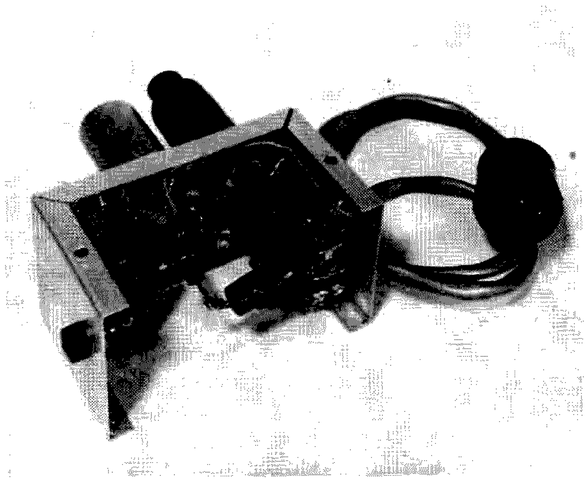


Table I

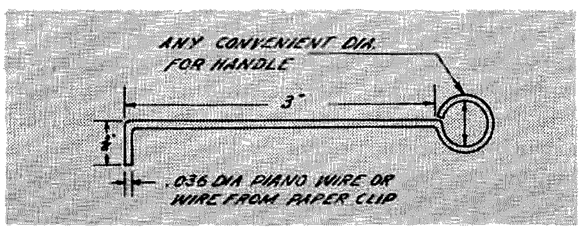
Call	Frequency kcs
NAA	15
GBR	16
FUB	17
NBA	18
NPG	19
NPM	20
NSS	22
NSS	64
NSS	88
NSS	122

Footnotes:

1. Editorial, **Electronics**, April 1943.
2. "VLF Maine," **Bureau of Ships Journal**, February 1960.
3. "New NBS Standard Frequency of 20 Kc Reported Furnishing Accuracies of 10^{10}", **Electronic Design**, May 11, 1960.
4. "Changes in WWV/WWVH Standard Broadcast", CQ, February 1961.

Viking Transmitter Adjusting Tools

Occasionally the owners of Viking Valient transmitters find it necessary to touch up the VFO calibration and adjust the modulator static current. To do this, it has been necessary to pull the rig out of its cabinet. This, in turn, requires the removal of numerous screws, connectors, etc. This lengthy operation can be completely eliminated through the use of a couple of paperclips or lengths of .036 dia. piano wire. Here's how it is done.

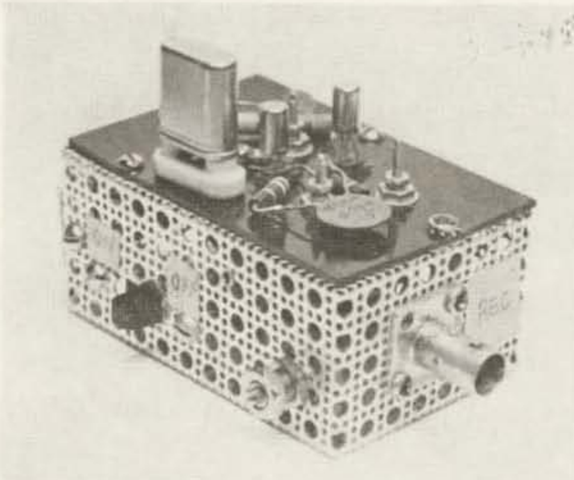


After selecting your material, bend it into the shape and size shown in the illustration. The adjustments can be made with one tool; however, two will make the VFO calibration adjustments easier.

To adjust the modulator static current, insert the "L" shaped end of the wire tool through one of the vent holes in the side of the cabinet. Then engage it with the slot in the shaft of the appropriate potentiometer. The current can be easily adjusted by turning the ring end of the tool.

To calibrate the VFO, use two of the wire tools. Insert them through the vent holes in the cabinet in a location so as to engage the slots in the high and low frequency adjustments for the range to be calibrated. The normal calibration procedure can then be followed and adjustments made by turning the ring ends of the tools as necessary.

These same tools may also be useful in making similar adjustments on other models of Viking transmitters. . . . W6NKE



"Little NIC"

6 Meter Transistor Converter

Capt. John J. Sury K8NIC/5
39 Nebraska Road
Dyess A.F.B., Texas

The popularity of transistors among the hams is increasing by leaps and bounds. The prices are reducing within reach of our building hams (which are getting fewer by the day). With the advent of VHF transistors hams, designers and manufacturers have been experimenting to make the transistor practical for receivers, converters and transmitters. Because of their size and low power requirements they become the ideal device for miniaturization for mobility. The author attempted to design and build a simple miniature converter with the least amount of components and folding stuff and still maintain performance. The results of such endeaver is the "Little NIC" 6 meter converter designed for portability with the Heath Kit Mohican transistor receiver. Any receiver can be used that tunes from 7 to 9 mc without not too much of a modification. This little gem lays nicely in the palm of your hand.

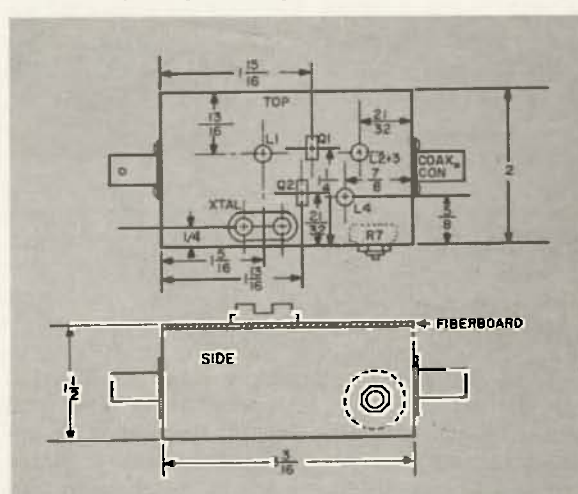
The chief items consist of 2 transistors and an overtone crystal. The remainder of the parts are normally found in a builders spare parts box. It may be tuned to either 7 mc *if* or 8 mc *if* without changing anything except the crystal. A 42 mc overtone crystal was used in the authors model. A 43 mc crystal was tried with equal success. All that has to be done is retune L2 and L4 for max. L1 need not be retuned because it is broad.

It should be noted on the schematic several transistors are mentioned for Q1 and Q2. The RCA 2N1177 rf and the 2N1178 oscillator transistors do a terrific job. These are two new transistors by RCA for FM receiver application. By experimenting it was found that these transistors made the converter more sensitive than the others tried. The 2N384 will also do a fine job. The 2N247 may be used in the oscillator section with less sensitivity because of its lower frequency cut off.

The 5K pot (miniature) R7 is used to set the correct voltage from the 9 volt battery. The converter requires approximately 7½ volts at 2.5 ma. By using a pot in series with the miniature 9 volt battery for storage ease in the converter as the battery voltage drops the pot resistance is decreased. The battery should last a long time for continuous service. With the advent of 9 volt transistor radios these batteries may be purchased almost anywhere.

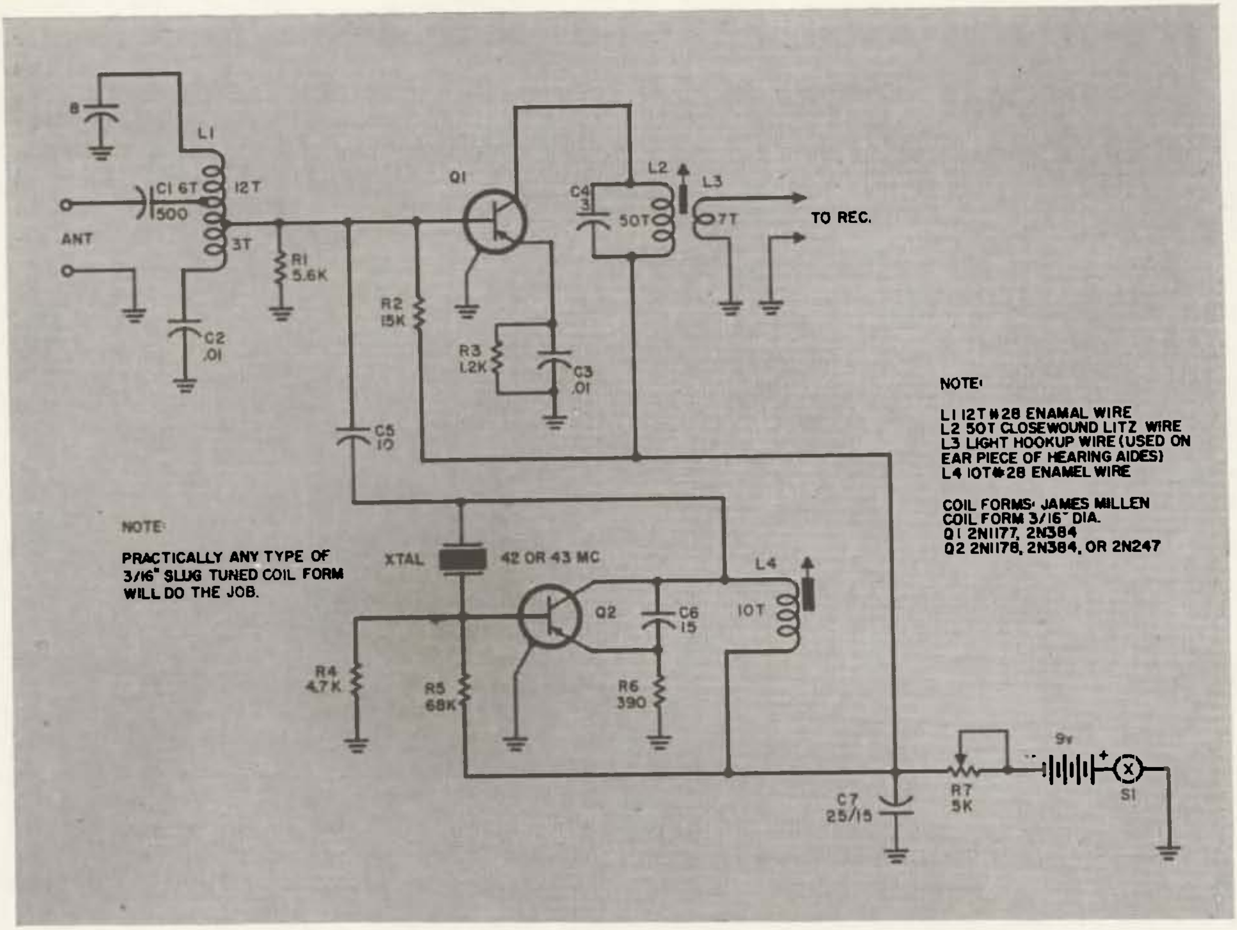
The construction will not be covered in detail because of the simplicity. The wiring is not critical so no difficulty should be encountered, just follow the schematic.

The chassis is a 2 x 3-3/16 x 1/16 inch fiber board. Refer to the chassis layout to get the approximate location of the components. A piece of "do it yourself aluminum" (the author used perforated) which may be obtained at any hardware store is formed into a box and the chassis is mounted on it (see layout). The box serves as a switch mount, pot mount, internal battery mounting and RG-58 coax fittings. Wire converter as indicated on the schematic.



In winding your coils a grid dipper will keep you on the right track. On L1 the coil tap to the base of Q1 should be one fourth of the turns from C2 and the antenna tap one half of the turns.

To align the converter hook it up to your receiver. Tune the receiver to the desired *if.* Turn the converter on. Using a 50 mc signal generator or grid dipper adjust the slugs and R7 for max. sensitivity. Putting a multi-meter in series with the battery to measure current will give an indication of whether the crystal



is oscillating or not. By touching the oscillator coil L4 the current will change slightly if the crystal is oscillating. If it is not oscillating the current will not change.

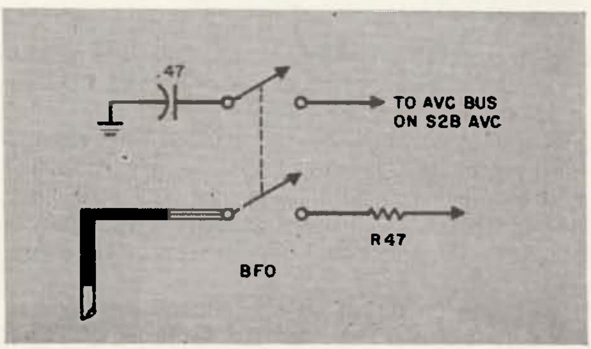
By changing L2 to the standard AM broadcast band and changing L4 and the crystal to resonate at 49.3 mc, it should work fine with an auto radio. A filter in front of the converter may be required to filter out the strong AM signals. Get 'er built for the coming 6 meter DX season. Good hunting.

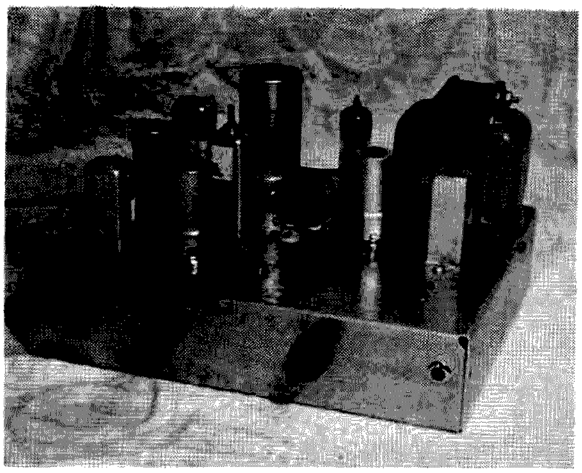
. . . K8NIC/5

Improved Side Band and Reception for the SX-111

This simple circuit change to the SX-111 receiver will improve its operation on SSB and does not involve the mutilation of the receiver in any way. The only parts required are a double pole single throw bat handle toggle switch and a .47 mfd-100 WVDC tubular capacitor. The change consists of replacing the BFO switch (S6) with the DPST switch. Re-connect the BFO wiring to one side of the switch. From one contact on the other side of the switch connect the .47 mfd condenser to ground. Connect the remaining contact of the switch to the AVC line at the AVC switch (S2b). The circuit is now wired so that when the BFO is on a .47 mfd capacitor is connected from the AVC line to ground. This will provide for a fast attack-slow decay action of the AVC circuit. The S meter will now work on CW or SSB with the AVC on, and the RF Gain control may be run wide open with the audio turned down to a comfortable level.

. . . WøRQF





Part II

A New Panadapter Unit

J. H. Ellison, W6AOI and R. L. Hopton, W6LQK

LAST month we described a panadapter unit to be used in conjunction with any oscilloscope and went into some detail describing the advantages of panoramic reception. We pointed out the types of information that could be gleaned and indicated the uses for it, and stressed the fact that a comparatively simple and inexpensive adapter unit would make it possible to use your station oscilloscope for this purpose. This is accomplished with only a minor modification to the scope, which rather than detracting from its utility actually adds to it because there are other uses for the scope which require this modification. We also described the theory behind the frequency sweep system and the method of synchronization selected for it. Since these two are the most important parts of the panadapter it is essential that they be clearly understood in order that you won't be tempted to make substitution of components or values that can get you in trouble in trying to get proper performance from the unit. We don't mean to imply that changes can't be made but please, —again we say,—please read the first part of this article so you will know why certain things were done as they were. (Frankly, we are just trying to eliminate the letters that describe multiple changes in a unit "constructed exactly in accordance with your description which doesn't work, and who are you trying to fool?")

Assembling the Unit

The circuit is reproduced here as Fig. 1 and was described last month. The chassis layout, Fig. 2, is made on a 7" x 9" x 2" aluminum chassis such as the *Bud* type AC-406. As you can see from Fig. 2, and the photographs, this size chassis accommodates all the parts comfortably, if you are reasonably handy with the "tools of the trade." Lay out the chassis and use socket punches for the *if* transformers and tube sockets, but be reasonably careful and accurate so you will not encounter interference problems when mounting and wiring. The *if* transformers known as "K-Tran" by *Miller* are recommended because of the ease of mounting. Unfortunately, there is no K-Tran available for T-3 so you will have to drill the seven holes to mount the type available. T-3 must be modified before mounting to provide the center tap. Remove the secondary condenser and replace by two condensers of twice the value connected in series and with a center tap lead brought out through the bottom of the can. The orientation of each transformer and tube socket should be checked from the photos and the wiring diagram to get short, direct interconnecting leads. Check the loop-stick for length before mounting. You may have to trim the end of the paper from about one-eighth of an inch with a razor blade so that it doesn't project below the bottom of the chassis. Then wind a 8-9-turn tickler winding at the mounting end of the loop-stick about one eighth of an inch from the main winding. Leave the leads long enough to be able to reverse them if the oscillator doesn't "take off." This may seem to be a very small tickler winding but that is what we ended up

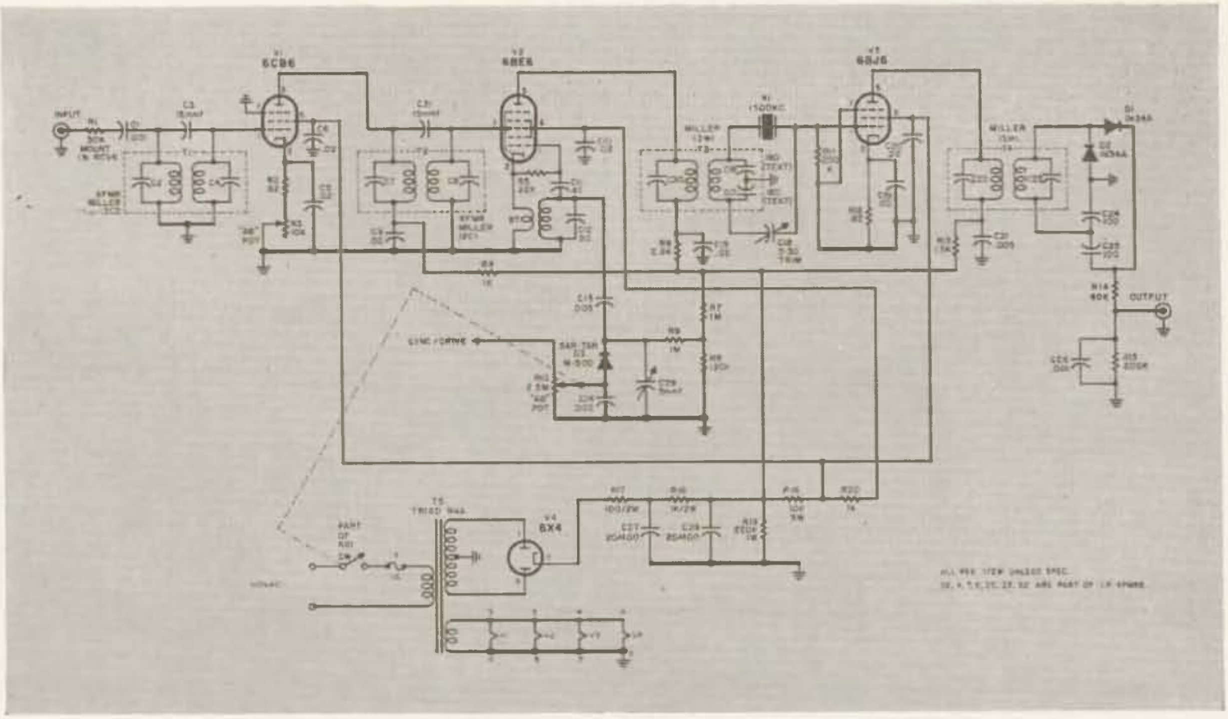


Fig. 1—T6 is a standard ferrite-cored loop stick. This was discussed in last month's text.

with. There are two sub-assemblies that should be made before mounting. One is the detector circuitry seen in the upper right corner of the bottom photo, and the other is the decoupling resistors seen at the lower middle. The detector circuitry is wired as in Fig. 3 on a small plaque or terminal board 1¼" x 1½". Watch the diode polarity or you may end up an upside down picture. The decoupling resistors can be assembled on a terminal board as we did or hung out in the wiring if you prefer. Those on the board from left to right are R4, R6, R13 and R16. There seems to be no difficulty with wiring dress; we used the most direct approach in most cases, only keeping clear the area around the crystal and trimmer. Unwanted capacities there might cause ringing in the crystal due to feed-back or degrade the selectivity and picture due to signal feed-through.

A few words now about certain components are in order. The connectors on the rear apron are the threaded type jacks that fit the conventional *RCA* phono pin plugs. The fuse mount is desirable, but not essential. Similarly desirable, but not essential, is the small pilot light on the front apron. It is a neon assembly running off the 115 ac line through a 100,000 ohm resistor. It won't light up the shack like a Scotchman's reading lamp as some pilot lights do, but will remind you that the power is on. As stated previously, the crystal doesn't have to be 1500 kc exactly. It need be only within the tuning range of the associated *if* transformers. Plus or minus 20 kc would still be satisfactory. We used a plug-in type filter condenser because it was convenient and available,—other types will do as well. Any power transformer delivering the same voltages and currents will do if it fits the space. Note the location of the soldering lugs before you assemble and mount the components and you will save time and have short ground returns. There are two on T1, two on V1, one on T2, two on V2, two on the crystal socket and one on V3. The two *if* tube types were chosen for high transconductance, but there are other types that match the same socket connections. In fact, if the suppressor connection is returned to cathode instead of ground many tube types are suitable, but check the Tube Manual first. In general, we might say that the components specified fit easily in the space, but if you substitute indiscriminately, you're on your own. If a cabinet is desired for the unit, the *Bud* CU-879B will take the chassis with the cabinet covers on top and bottom instead of front and rear. This is a real convenience for access. No special sequence is necessary in wiring except for the sub-assemblies previously mentioned. The decoupling resistors are used in the plate and screen supply leads as normal precautions against interaction and instability. They

were put in at the start, not as corrective measures. All other components can be identified from the photos.

There are two items to be taken care of in the associated equipment, the receiver and scope, and they might as well be gotten out of the way first. If we don't, we reach a point in alignment where we have to stop and do them before we go on. So first to the receiver; —as mentioned last month, connect a 50K resistor to the plate of the mixer tube and bring the other end of the resistor out via a shielded cable to the input of the adapter unit. Try to keep the length less than 30 inches so that the cable capacity doesn't shunt off the signal appreciably. If you make up the permanent cable instead of the temporary rig you won't have to peak up the front end after tune up and alignment. Next refer to your scope schematic or Instruction Book and find the lead from the horizontal amplifier plate to the scope deflection plate. This is the lead that is going to furnish us with the horizontal sweep voltage for the adapter. Connect a .05 mfd ceramic condenser to this lead and bring the other side of the ceramic condenser to an

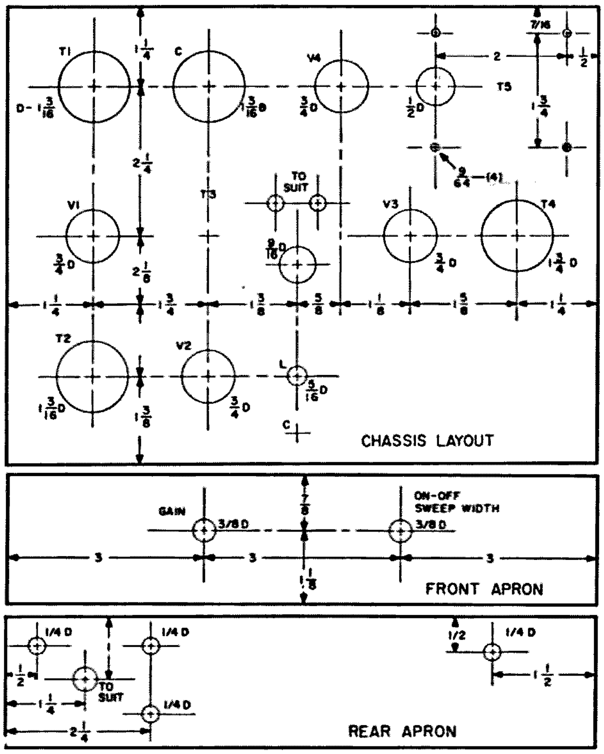


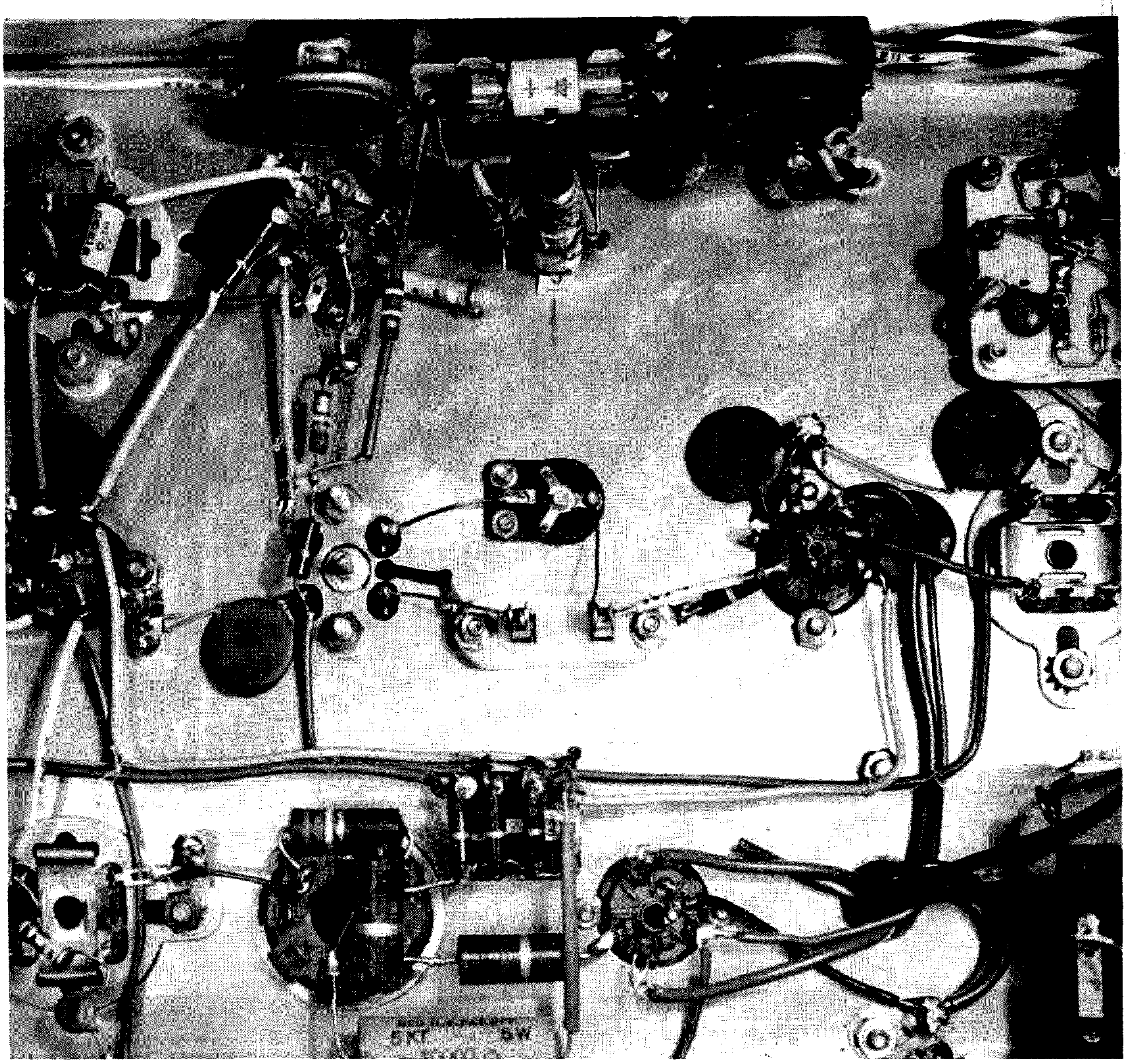
Fig. 2

insulated pin jack on the outside of the scope case. Don't worry about the voltage magnitude available, it will be more than enough.

The first step in aligning the unit is to get the 1500 kc *if*'s on frequency, which will be the actual frequency of the crystal. This alignment is not critical because the pass band of transformers at this frequency is at least 20 times that of the crystal. Set the crystal trimmer at about half capacity and remove the crystal. Couple a VTVM to the detector output and feed a frequency corresponding to the crystal into the 6BE6 mixer plate and align the two *if* stages in the usual manner. Just be sure that the mixer oscillator sweep is at zero and that its frequency is well above 1500 kc by backing the slug all the way out. Once the *if* transformers are aligned, no further touching up is necessary because of their broad selectivity relative to that of the crystal. Their sole function is gain.

The next step is to get the mixer oscillator strength set and on frequency, assuming it is oscillating. Screw the slug well in and find the oscillator signal in the upper part of the Broadcast band. Use a short wire from a broadcast receiver antenna connection hooked over the loop-stick to get a quick check of where you are. If no signal appears, reverse the tickler leads. Once the oscillator is running, measure the dc voltage on the oscillator grid with a VTVM. Between —5 and —8 volts is satisfactory, but it *must not* be higher or you will be in trouble. As explained in last month's article, the rf swing of the oscillator and the sweep voltage swing must not overlap. Hook up the output of the adapter to the scope vertical amplifier input and hook up the sweep take-off from the scope to the sweep input jack on the adapter. Set the scope sweep at about 30 cycles and sync it to the ac line in whatever manner your scope does this (internal switch or external jumper). Increase the scope horizontal gain to draw a base line and position the base line somewhat below center. Now we will check the adapter oscillator performance. Measure the dc voltage on the diode cathode with the sweep control at zero. (Use a VTVM because any other type will give a false reading if the meter requires current.) It should read 18.5 to 19.0 volts. If it doesn't, the resistors R7 or R8 in the voltage divider must be adjusted to give that reading. Now, leave the VTVM connected and advance the sweep control to about half scale. If there is *any change* in the voltage reading on the diode cathode it shows that the diode is conducting and either the mixer oscillator bias is too high or the sweep is too great. Assuming that we have adjusted this properly, the oscillator should be set by the slug to a frequency which is the sum of the main receiver *if* (455 kc or thereabouts) and the crystal frequency (nominally 1500 kc). Don't bother with the band center control at this time, it can be set later.

Now we can get the crystal filter circuit lined up properly. Put the crystal back in the adapter and feed a signal to the adapter mixer grid at the *if* frequency of your receiver. Now advance the sweep width control about one quarter open and the crystal response curve will appear on the scope. You have three adjustments to play with, namely, the crystal trimmer or balancing condenser



and the crystal input transformer primary and secondary. Get the maximum height response with the primary first. it won't need any further peaking. Now peak the response with the secondary and start adjusting the crystal balancing condenser. You will see the crystal rejection notch appear on one side of the curve as you adjust, then the curve will become symmetrical, and then as you continue adjusting you will see the notch appear on the other slope of the response curve. Work the secondary tuning and the trimmer tuning together until you are satisfied that you have the best compromise of the three factors, response shape symmetry, least response curve width and maximum response height. Notice the shape of the curve when the notch is present. The skirt at the notch is practically vertical but the other skirt slopes off at quite an angle, and the response curve is rather broad at the base line. The symmetrical curve with no notches will be rather less than half as wide at the base line, indicating better selectivity and better resolution. This is a vivid representation of what happens with your receiver crystal filter when you try to "notch out" an interfering signal. You may knock out one but you open the gate for other low level interference. Now vary the sweep width control and you will see the response curve grow wider or narrower as the crystal passband becomes a larger or smaller percentage of the total sweep width.

The next step is to adjust the broad band input stages of the adapter. This requires a signal generator that will tune from 400 to 500 kc. What we want to achieve is a response curve in the adapter which has a hump at both the low end and the high end of the pass band. The companion receiver will produce a hump response in the middle of the pass band and if the three humps are appropriately spaced the result will be an over-all response that will be fairly flat. This flat response will result in all signals on the scope showing up with their true relative strengths. The most satisfactory approach to reach this condition is to make a preliminary adjustment of the adapter by itself, followed by a further adjustment in conjunction with the receiver.

The reason for this is that no two receivers and antenna systems have the same response curve, so that the desired flat response can only be obtained with your own receiver and antenna. Although it is seldom mentioned, note that the receiver antenna trimmer adjustment can have a considerable effect on the shape of the response curve. Also, in a multiband receiver any lack of tracking in the oscillator, mixer and rf stages will distort the response curve shape. You can check your receiver internal alignment on various bands by this observation.

1. Put a 455 kc signal on V1 plate and tune T2 secondary (top) for maximum response on scope.
2. Put a 435 kc signal on V1 grid and tune T2 primary (bottom) for maximum response.
3. Put a 475 kc signal on V1 grid and retune T2 secondary for max. response.
4. Put a 455 kc signal on regular adapter input and tune T1 secondary (top) for max. response.
5. Put a 435 kc signal on adapter input and tune T1 primary (bottom) for max. response.
6. Put a 475 kc signal on adapter input and retune T1 secondary for max. response.
7. Repeat steps 2, 3, 5 and 6 to peak responses.

Now hook up to the regular receiver and find a steady non-fading signal (or feed in one on a fundamental signal) on some convenient band. Tune it in carefully, peak the antenna trimmer and then tune from about 40 kc below to 40 kc above the signal while watching the scope. It should remain fairly constant in height (plus or minus 20%) if your adjustments are correct. If there are very low or very high response points anywhere but the very edges of the picture, touch up T1 and T2, but go easy. At this point all touchup adjustments interact and some compromise must be accepted. On the other hand, if you have access to a multi-vibrator for rf you can use it now as a signal source and see the entire response curve like a picket fence and very quickly get the best over-all adjustment.

Band Center Adjustment

The band center adjustment is pretty obvious. With the receiver and adapter warmed up and stabilized, pick a signal, tune it in exactly by ear, put the band center control at mid-position and center the signal on the scope by trimming with the oscillator coil slug. You should calibrate the sweep width control by means of either a signal generator on a high frequency band or by a receiver with a calibrated dial. Tune the generator to move the signal from the middle of the scope to the edges, both directions. Don't try to get too much sweep, 5 kc, 20 kc, and 40 kc are suggested points, each of course, giving plus and minus the amount from band center. Remember that the sweep width setting in kc is a true setting on any band because it is a percentage of the *if* frequency, which is fixed. This completes the alignment of the unit. To many it may appear we have gone into too much detail, but we have tried to give a detailed description in proper sequence and cover questions that might arise from those who are not familiar with panoramic receivers. We hope they can get a clearer picture of its operation while building and aligning it. Of course, no amount of words takes the place of actually going through the steps by oneself either in an original approach or following someone's description. Fortunately, there is very little in the entire job that can go out of alignment so you can be assured of long time satisfactory performance when the adapter is finished.

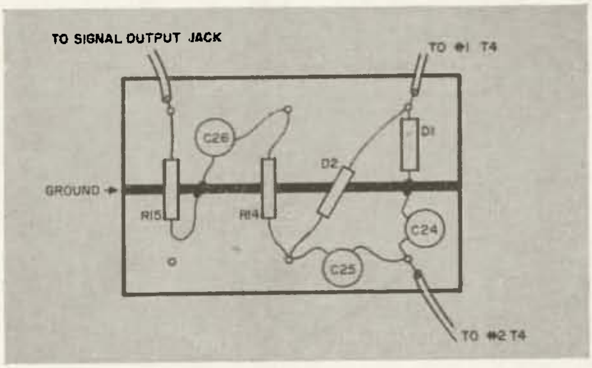


Fig. 3

Interpretation of Patterns

In the text of both parts of this article we have described in more or less detail, the types of information produced by the panadapter. Now let's consider some of the patterns, first those appearing at normal sweep, say a sweep of 20 kc where a signal is fairly narrow. Fig. 4a is a typical CW signal (or an unmodulated carrier) which appears and disappears with keying. A frequency shift keyed teletype signal will look the same as an unmodulated carrier except that it seems to jitter erratically with the keying characters. A carrier with FM applied will "fuzz up" with modulation as in Fig. 4b and clear up with no modulation. Note the similarity of all these signals. They are all characterized by a constant amplitude signal, neglecting fading, of course. All appear as signals originating at the base line and reading up from it, rather than signals reading above and below a middle axis. This is because we are viewing a *response* curve and not actual rf or af voltages. Pulse noise such as ignition noise will appear as in Fig. 4c. Either spikes or triangles or both may occur. They usually appear at several points, equally spaced, and do not move with tuning although they may run slowly across the scope either way. This is typical of ignition type noise. They are also

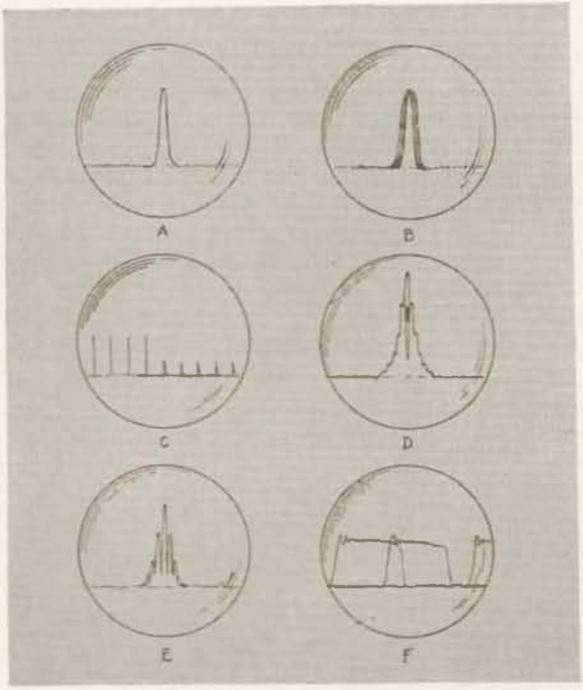


Fig. 4

constant amplitude signals because the offending source is usually close by and no fading exists. This persistent regular pattern is typical of man-made interference as contrasted with static or random noises which appear in short irregular bursts.

Now consider an AM signal which will look like Fig. 4d with modulation. You will note that this signal while still having the response curve shape, varies in amplitude about a middle level which is the unmodulated carrier, and swings with 100% modulation to twice amplitude and to zero amplitude in the audio cycle. Unsymmetrical modulation can be determined by comparing the amount of swing above and below the mean when a steady modulation tone is used. Over modulation will be manifested by an excess of the upward swing over the downward swing combined with the appearance of bright spots on the downward peaks at the base line. When this occurs you will frequently find splatter pulses spaced each side of the main curve and synchronized with modulation. Don't be misled into thinking these low amplitude peaks are unimportant. The reason these are small on the panadapter is because they are at the edges of the response curve, but to the listener tuned to those frequencies they are anything but small.

SSB signals appear in bursts at a fixed point on the scope. They resemble Fig. 4e instantaneously, but emanate from the base line like a keyed signal. In fact, they are keyed signals of many frequencies, the sideband frequencies generated by the voice in the suppressed carrier system and transmitted simultaneously. We don't see them as separate spikes because they run together, shift and overlap. If we could trace the outline of all these frequencies at any one instant we would get a curve just like that produced by an AM signal. Again, this is because we are viewing a response curve so we will not see an unsymmetrical group right or left representing upper or lower side band, but we will see extensive amplitude variations.

All the foregoing discussed wide sweep patterns. If the sweep is narrowed to say 3 or 4 kc each type of pattern will broaden to fill the scope face. A teletype signal under this condition reveals some interesting information about fading and multiple path propagation. You will see the two response curves representing mark and space separated by the frequency shift, and you can see each fading relative to the other, even though the time interval between them is measured in milliseconds. Since fading is a measure of multiple path lengths, absorption and many other things this gives us a mental image of ionospheric propagation which is rather different from the popular conception of a reflecting surface. This and other pictures indicating drastic fading shows us how our receivers and the human ear average out signals over time and intensity to produce copyable signals.

At zero sweep and with the receiver and adapter centered on a signal, we can see the modulation frequencies on an AM signal just as the audio would appear on a scope, swinging equally above and below a horizontal axis. The same picture could be obtained with a SSB signal if a strong local signal to supply the carrier is injected at the antenna. Normally, keyed signals fluctuate so radically that the signal biases itself off the scope. The level of a CW signal, however, can be set to show keying characteristics even though a stationary pattern can not be had. You will get a picture like Fig. 4f at any instant. The leading and trailing edges of keyed characters can be caught "on the fly" and transients that produces clicks and key thumps can be plainly seen.

The last few paragraphs on patterns will give you a starting point for making use of the panadapter other than as a signal seeker. You will find many more than we could tell you about. Perhaps you will be interested enough to pass on such information to the rest of us, either on patterns or on other uses for the panadapter. We haven't exhausted its potentialities by any means in this article. One nice feature which wasn't planned is the control obtained at narrow sweep. One of the major difficulties in an original design is resisting the temptation to "improve it" long enough to use it and write it up for others. (The Editor sometimes gets difficult, too!) Well, we resisted the temptation (so far) and wrote it and we will leave it to you to improve it. . . . W6LQK . . . W6AOI

Plate Modulate Your DX-40

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The advantages of plate modulation over screen or cathode modulation are considered to be worth the extra cost of the relatively higher powered modulator required. This article describes a simple modification of the DX-40 to allow its use with an external plate modulator, yet allows the operator to return the DX-40 to its original circuitry at the flick of a panel switch for built-in controlled carrier modulation, or for CW operation. The only parts required are a simple DPDT switch, a resistor, a small terminal strip, two banana jacks, a double banana plug, a couple of feet of hook-up wire—and the modulator.

The UM-1 Universal Modulator (Globe Electronics, $34.95 in kit form) is ideal for plate modulating the DX-40. It furnishes 25 watts of audio, so running the DX-40 at slightly over 50 watts input results in almost 100% modulation. Signal reports verify the improvement with plate modulation, especially under poor band conditions or QRM.

The schematic showing the changes (Fig. 1) is almost self explanatory, especially when compared to the DX-40 schematic in the Heath manual. However, for those that prefer to make the changes step-by-step, here are the details:

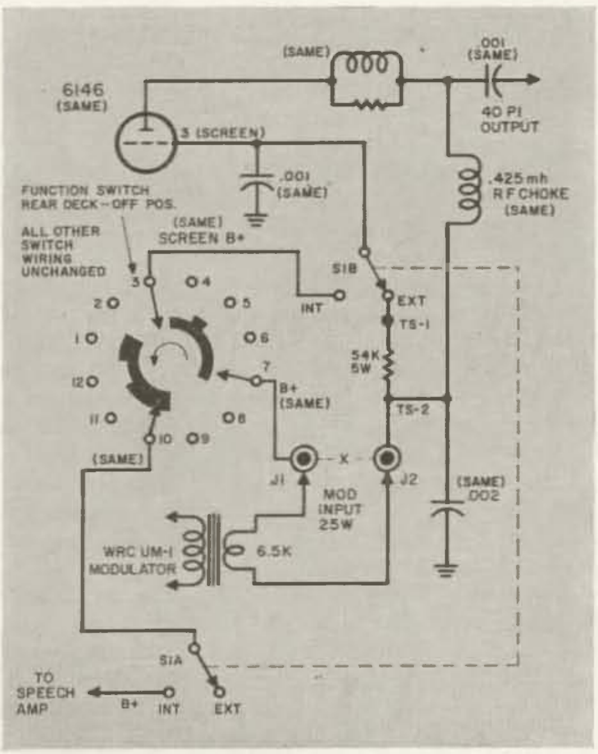


Figure 1. DX-40 circuit changes for plate modulation.

(Refer to Fig. 1 and Photo 1)

(1) Install a DPDT switch, toggle or slide type, between the key jack and the function switch on the front panel of the DX-40. This switch will be called S1A and S1B.

(2) Install two *insulated* banana jacks (J1 and J2) on the rear apron between the mike input and the antenna output connectors. Space these banana jacks so that the centers are three-quarters of an inch apart, to allow mating with a double banana plug from the modulator.

(3) Remove the wire from function switch lug #3 and solder this wire to S1B center lug.

(4) Solder a jumper wire between S1B "internal" lug and function switch lug #3.

(5) Install a two-lug terminal strip (TS1 and TS2) to the underside of the chassis in a convenient spot (see Photo).

(6) Connect (do not solder yet) a 54K 5 watt resistor (or one 10K 2 W and two 22K 2W in series) between the two terminal strip lugs TS1 and TS2.

(7) Solder a wire from S1B "external" lug to lug TS1 of the new terminal strip. (Note: Either lug may be considered TS1. The other lug will then be TS2.)

(8) Remove the wire from function switch lug #7 and connect (but do not solder yet) to terminal strip lug TS2.

(9) Twist two 14-inch long insulated wires together to make a twisted pair. Strip ¼-inch of insulation from each end of both wires.

(10) At one end of the twisted pair of wires, solder one wire to banana jack J1 and the other wire to banana jack J2. Route the twisted pair along the existing cabling on the underside of the chassis to the front panel.

(11) Solder one of the twisted pair wires to function switch lug #7.

(12) Solder the other twisted pair wire to terminal lug TS2.

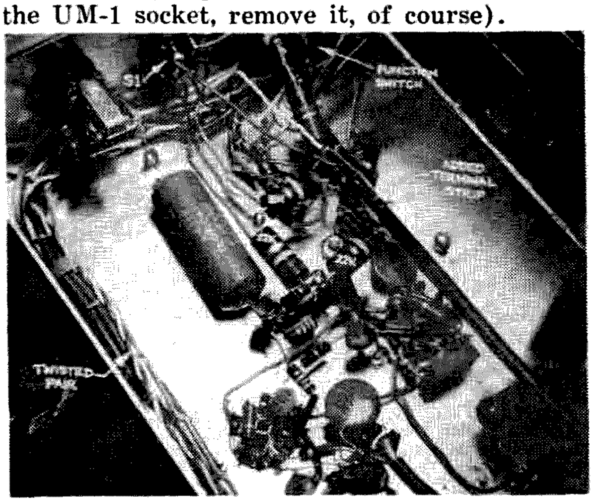
(13) Remove the wire from function switch lug #10 and solder it to S1A "internal" lug.

(14) Solder a jumper wire between center lug of S1A and function switch lug #10.

This completes the wiring. Now here's the way to use the DX-40 now that it's modified:

Plate Modulation Operation

(1) Put the new switch S1 in the "external" position.
(2) Plug the modulator output (pins 1 and 8 of the UM-1 accessory socket) into J1-J2 banana jacks just installed on the back of the DX-40. A double banana plug is very convenient for this connection. The modulator output tap should be about 6000 ohms. If you are using the UM-1 the 6500 ohm output tap will match the DX-40 very nicely.
(3) Connect your microphone to the modulator input.
(4) Put the DX-40 function switch in the "Tune" position and adjust the grid drive to about 2-3 ma.
(5) Put the function switch in the "Phone" position, dip the final and load to 100 ma. plate current. Operation above 100 ma. is not recommended in this mode.
(6) Advance the gain control on the modulator as you speak into the mike. You will probably hear the modulator talking back to you a little and the plate current needle on the DX-40 may flicker. Adjust the grid drive control to stop the flickering during modulation. With the UM-1 and a crystal mike the modulator gain control may be run "wide open". Don't eat up the mike, however. Adjust your voice power and mike distance from on-the-air checks or with an oscilloscope.
(7) When using the UM-1 Modulator, it may be switched on and off with the DX-40 automatically. Just connect the coil of a 115 volt 60 cycle relay to pins 5 and 6 of the DX-40 accessory socket and connect the contacts of the relay (the normally open contacts) to pins 4 and 5 of the UM-1 accessory socket. (If there is a jumper between pins 4 and 5 of the UM-1 socket, remove it, of course).



Controlled Carrier (Internal) Modulation

(1) Remove modulator input plug at J1-J2.
(2) Put a jumper across J1-J2. (A double banana plug with a wire jumper makes a quick change even quicker).
(3) Put the new switch S1 in the "internal" position.
(4) Connect your microphone to the DX-40 mike input connector.
(5) Since all internal wiring is now electrically identical with the original wiring, the DX-40 should now be operated just as if you never saw this article in the first place.

CW Operation

Follow steps (1), (2), and (3) described above for Controlled Carrier Operation. Then follow step (5).

That's all there is to it. Whew!

. . . K6UGT

Note 1: Use 10K 2W and two 22K 2W (or similar) in series. Screen current is approximately 8 ma. **Note 2:** When controlled carrier operation is desired short out J1-J2 and switch S1 to "Internal." Don't forget to change the mike from the modulator to the DX-40. **Note 3:** Switch S1 mounts nicely on the front panel. J1-J2 are banana jacks which mount on rear apron of the DX-40, near the mike input. **Note 4:** When using the external modulator load to 100 ma plate and 2-3 ma grid with the function switch on "Phone." Adjust the grid drive for a steady meter when modulating.

Minimizing Test-Lead Requirements

When you're using several types of test gear in the shack, the number of different types of test leads required rapidly reaches the point of total confusion.

The usual snarl of test leads can be reduced to only two or three sets simply by standardizing the connectors used on the various items of equipment. One of the best connectors to use for this purpose is the ordinary mike fitting (Amphenol Series 75 or equivalent). This connector is a modified coax termination for rf gear, a completely shielded joint for audio and low-level meters, and it isn't so expensive that conversion of all your gear will drive you to bankruptcy court.

Typically, three 3-foot leads—one made with flexible coax such as RG-58A/U, one with mike cable, and one with test-lead wire—will be enough. Use gator clips on the other ends, or a set of universal test prods. A 3-foot extension of RG-58A/U with a type 75-MC1F connector at each end adds to the versatility.

. . . K5JKX/6

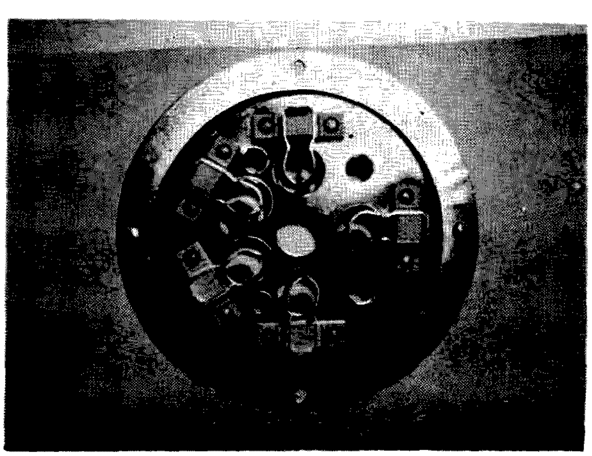
An Economical Socket for the 4-1000A

ONE of the juicyest items to appear on the surplus market, at a now modest cost, is the 4-1000A. Of the many virtues this tube has is it's excellent application to grounded grid linears, by now well covered in popular literature to date, therefore not requiring repetition here. Even the 7½ volt filament transformers necessary have appeared at reasonable prices as surplus. So far, so good—but not the sockets!

A search through the latest stock market reports and the usual local stores, as well as inquiries over the air, failed to reveal any source of supply. It seemed downright discouraging to pay more for a socket than for the tube!

The tube manufacturer's specifications recommend forced-air cooling be provided in order to maintain base seal temperatures below 150° centigrade, and the plate seal below 200°. The air-flow rate recommended is 30 cubic feet per minute below 30 megacycles, rising to 45 cfm at 110 megacycles. However this sturdy jug has the capability of more than 3 kilowatts average plate input, which is considerably more than the law allows amateurs. This fact would lead one to the idea that a lesser input could get by with less stringent specifications due to the lesser temperatures encountered when operating at less than one-third of the maximum ratings.

The specifications go on to say that in the event an air-system socket and air chimney are not used, air must be circulated through the base of the tube and over the envelope surface and plate seal in sufficient quantities to maintain the temperatures below the maximum ratings. Also, that seal-temperature ratings may require cooling air to be supplied to the tube if the filament is maintained at operating temperature during standby periods.



Further socket research revealed that among the tubes with the same *pinning* are the Amperex type 6079/AX-9908 which has been used in both commercial and amateur class C and linear amplifiers. The same pinning is used for the industrial triode type 5868/AX-9902 and a new SSB developmental tube type QB 5/2000. The ratings for the latter looks mighty interesting for amateur use both in grounded grid and grounded cathode, and the author feels that it is worthy of an article describing its characteristics. None of these tubes require forced air cooling, and the socket used is the Amperex S-3703, available through distributors at $4.50 net.

While the socket assembly is not recommended for the 4-1000A due to the forced air requirements, it is easily modified. It is metal with ceramic pin supports, rather than all ceramic. There is enough clearance between the pin supports to drill holes matching the base holes of the 4-1000A, thus providing a means for the air flow to the base seals, and, should a chimney be used, to the plate seal.

As may be seen in the photo, the distance between pins 2 and 3, and 3 and 4 is greater than between the other pins. These two holes were drilled with a 5/16" bit. The other three were drilled with a 17/64" as the maximum size permitted by the available space. Of course these sizes are not critical, but should be as large as possible as long as care is exercised to insure the holes are not so large as to damage the ceramic pin standoffs while drilling. It will be a much easier operation if you use a center punch marking the center of the widest space between each pin, as may be seen in the photograph. Drill a small pilot hole first. This hole will automatically be aligned to the 4-1000A base holes if care is used in centering, a not too difficult process. The entire operation can be done faster than it takes to tell about it.

A word about chimneys. You may be wondering where to get a suitable glass chimney. You can use a metallic fruit juice can, which would be satisfactory. In case this seems startling, I have some 4-250A sockets taken from surplus equipment which use metal chimneys. Admittedly you will miss the beautiful glow outlining that pretty rosy-hued plate. My good friend Ike, W9RUK has been running his 4-1000A for about two years without a chimney and without adverse results. He just uses a fan aimed at the tube, using this socket. As a matter of fact, he hasn't even drilled holes in it. He just mounts it *above* the chassis and allows the general flow of air from the fan to do the trick. Drilling the holes, however, will give you additional safety by improving the air flow distribution and will not interfere with later use of the 6079 or QB 5/2000. 73

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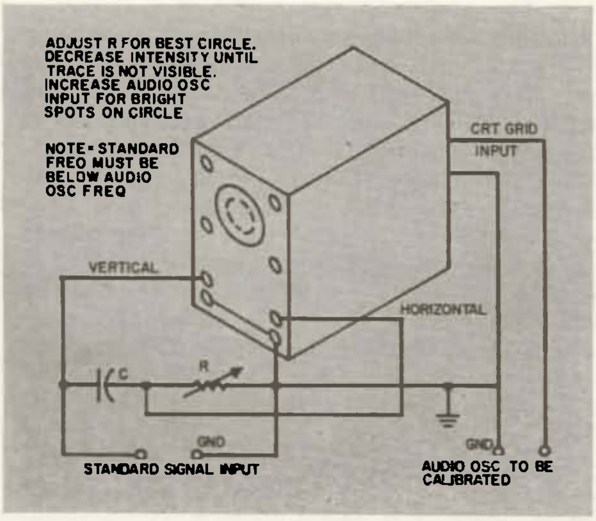

Fig. 3

Measuring Frequency with Simple Equipment

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Chattanooga 4, Tennessee

IN amateur radio, a knowledge of your operating frequency is essential for many reasons. First of all the FCC requires it. Remember the old saying, "don't fight city hall." Then too, would you tell a friend "shift frequency OM to 3.5 mc or so?" Or maybe, "our net operates at 29.2 mc, I think?"

No, we all have a very definite interest in determining frequency, sometimes even to the exact cycle.

Frequency measurement is possible in many ways, and each has it's own distinctive disadvantage. Possibly the simplest, and least accurate, is the absorption wavemeter, which is merely a parallel resonant circuit. Although simple to construct and operate, it is insensitive, and interacts with the circuit under test. If you had a coil with infinite Q, and coupling so loose there was no interaction, accurate measurements might be possible this way. The absorption wavemeter is useful in another way however, which I shall explain shortly.

The other type of frequency measurement equipment commonly in use by the amateur is the xtal calibrator. Usually either a 100 kc or 1000 kc xtal is used, mainly to determine the band edges. The disadvantage of this is that you may, unless very cautious, use the wrong harmonic and be 100 or 1000 kc off. A further question when using this type of measuring equipment is interpolation. By this I mean, how do you check your frequency if it is not an exact multiple of 100 kc? Elaborate calibrators use multivibrator chains to cut the signal interval to 10 or 1 kc. Some even have built in interpolation oscillators which can be calibrated internally and will cover a 100 kc interval. However, it is possible to measure

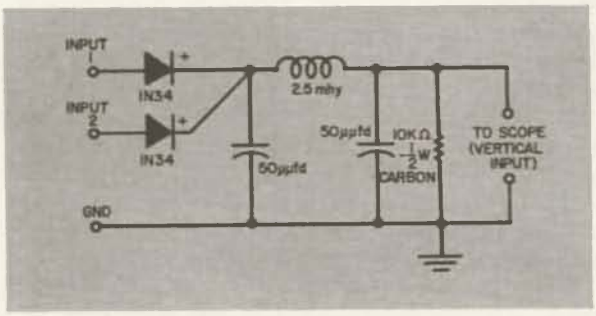


Fig. 1

any frequency exactly using only a minimum of equipment. A communications receiver is desirable, although not necessary. The absorption wavemeter mentioned previously can replace it. An oscilloscope, audio oscillator, and xtal calibrator are essential.

Added to the above equipment you must have a mixer, which can be built easily with two germanium diodes. See Fig. 1.

First though, before checking an unknown frequency, you must check and calibrate your equipment. The xtal calibrator can be adjusted against WWV, preferably at as high a frequency as possible. This should be done just before the unknown frequency is measured. Wait until the WWV tone stops, and adjust the calibrator to zero beat. When the tone returns, adjust the calibrator further until the chopping of the tone is as slow as possible. You may have to do this several times, to be sure of the correct setting. An error of one

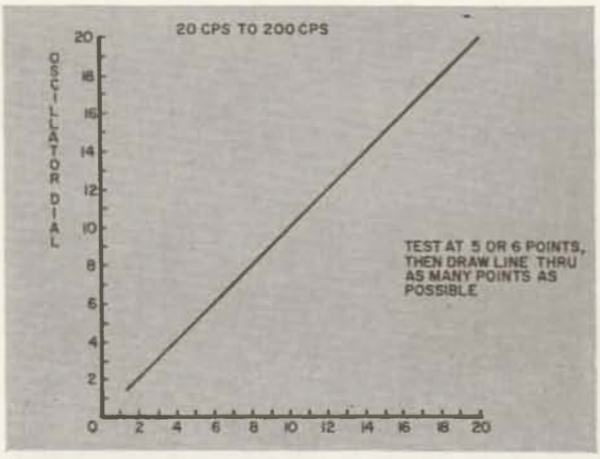
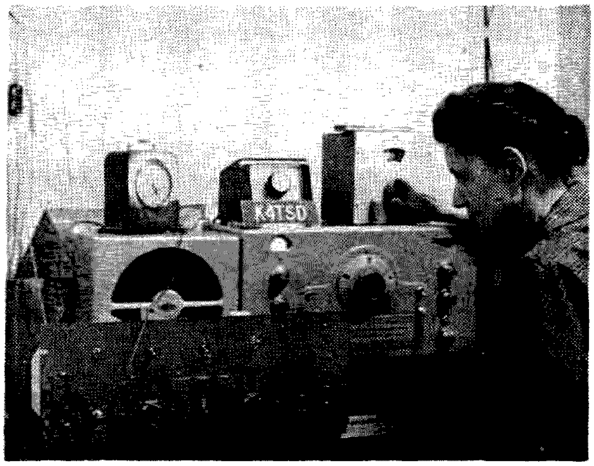


Fig. 2

cycle at 20 mc is an error of 0.000005%, which is close, *real* close!

Next you must calibrate your audio oscillator. In most cases it is easier to run a graph or chart on the dial error rather than try to rework the oscillator. The dial can be checked at several points, and a line drawn through these prints on a graph. A straight line should result. See Fig. 2. This chart can then be checked occasionally, and corrected. Let the audio oscillator warm up for several hours. Then, using the scope, check the lower frequencies against the power line frequency, using Lissajous figures. From 20 to 600 cps this should be possible. From 600 to 6000 cps you can use the 600 cps tone from WWV (connect the af output of your receiver to the vertical input of the scope), since ratios up to 10:1 can be read easily with Lissajous figures. Above 6000 cps use the 100 kc xtal calibrator. All the checks are made by applying the audio oscillator to the horizontal input of scope. The vertical input is connected to the unknown frequency.

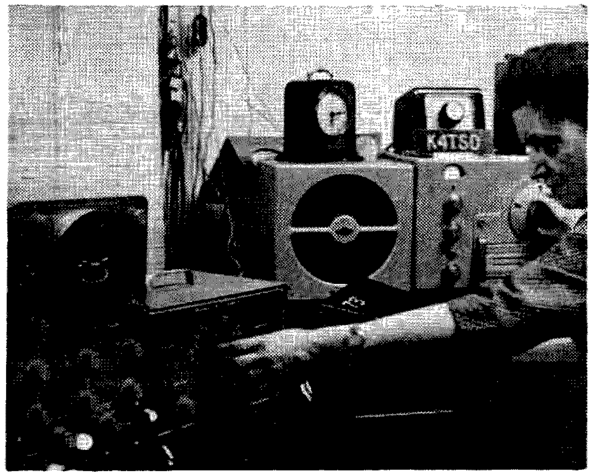


A custom built calibrator gives greater accuracy. The calibrator contains a 50 and 10 kc multivibrator chain, together with a 200 kc xtal standard.

An alternate method which can be used on some scopes is shown in Fig. 3. With this method of using intensity modulation of a standard circle, ratios of 100:1 can be read.

With your equipment calibrated, you now have the equivalent of a $1000 frequency meter. Now let's put it to work. The first thing you will want to measure is your transmitter frequency. Assuming you operate xtal controlled, use the following procedure (if you use a VFO, you will want to check the dial at several points on each range and run another graph).

You must determine the approximate frequency of the unknown signal first. Do this with your receiver and xtal calibrator or with an absorption wavemeter. In making this check, remove the antenna from your receiver and use only the oscillator or VFO stage of your transmitter. This will prevent an erroneous reading from an overloaded receiver.



Using the calibrated audio oscillator and oscilloscope to interpolate the beat between the xtal calibrator and the unknown signal. Do this several times to be sure of the result.

Now suppose your unknown frequency seems to be 3550 kc. Beat this signal with the xtal calibrator by using a mixer, such as the simple diode type described previously. The output of this mixer will be the difference between the 100 kc harmonic and the unknown signal, having a maximum of course of 50 kc. Apply this signal to the vertical input of your oscilloscope. The calibrated audio oscillator is connected to the horizontal input. Lissajous patterns can then be used to determine closely the beat difference, as in photo. If a three to one ratio is obtained at 16 kc on the audio oscillator, the beat difference is three times this or 48 kc. Our unknown frequency is found to be 3548 kc, with an error depending on the accuracy of the audio oscillator. If the oscillator is within 0.5%, and this is easily possible, our final measurement will be 240 cps or less, which figures out to be approximately 0.007% at 3548 kc. If a one to one ratio is possible, the error will be less. For instance, if a one

(Continued on page 65)

K4TSD is adjusting a home built xtal calibrator against WWV at 20 mc. By doing the calibration several times, it is possible to get it "on the nose."

Seymour Denby W2BNW
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From My Side of the Counter

AT least once every day, a customer—who may be a fireman or a successful lawyer, —will say to me, "I envy you, Sy . . . making money at your hobby. Nothing but radio gear all around. What a way to make a living!" Most of the time I don't answer; there *is* no answer to that one. But it's time, I think, to put down on paper one ham's reactions to living all day with his hobby.

I've been a ham since my teens—and let's not discuss when *that* was. Just for the record, I run a radio parts store on New York's Radio Row. We deal mainly in surplus, which means that I generally get a special kind of customer. I'd like you to come behind the counter with me for a while to see what it's like. In common with any businessman, I have to show a profit at the end of the month, and some of my reactions are colored by this fact. But, as a ham, I have more in common with my customers than most salesmen, and this makes things interesting.

On a Saturday, for example, the shop, which has little floor space at best, resembles the meeting-room of the local Key Klix Klub. There are hams and experimenters all over the place. Some come in just to look around and talk, and that's OK with us. Once in a while they buy something, and that's even better. Many of them are providing me with a liberal education, as well.

Take teenagers. There was a time when I could take a circuit out of a youngster's hand, fix him up with the components he wanted, and send him away happy. Nowadays it's not so easy. A kid will march up to the counter, squint at me through his glasses, and ask for "a dual linear precision pot, with extra lugs at the midpoints." And that's exactly what he wants. There's no point in my looking at the circuit; it's for a computer that I can't figure out, and anyway it's three pages long. I feel especially sorry for the fathers who come along to pay for the stuff. The kids are so darned superior that while Dad is still asking, "Do you think that this will do?" Sonny is already on the next item, a dozen diodes, "but all matched, please."

I still do get a kick when I can dig out a lot of parts for a boy, watch him count out the dimes and pennies, and see him come back next week, with the report that "I've already worked six states, Sy." Sometimes the pennies add up 20¢ short or so, but rather than take back a couple of resistors, I tell the kid to forget it. The big grin and the handful of QSLs he shows me the next time he comes in is worth it.

Not all of them are kids. Plenty of fathers have latched onto the game of ham radio to get some relaxation after a hard day at work. With luck, I catch them while they're Novices and watch them progress, learning as they go, through the thrills of DXing with a single 807 and on to bigger and better things. Radio is completely new to them, and an hour in a place like mine is likely to be confusing to a fellow who pushes a pencil all week, so I help them out just as I do the kids.

The older and wiser hams come in to swap lies, look around at the "new surplus" and very often pick up a gadget that I bought but can't make heads or tails of—there's a part in it that may be useful some day. That's how junk boxes are born. One item was an amplifier of some sort. It contained two sensitive relays and umpteen re-useable resistors, condensers and what-have-you. We had hundreds of them, and they are now sitting in ham shacks as small transmitters, converters, power supplies and whatever else the amateur imagination saw in them.

Apart from hams, we have many experimenters who come in for odd-ball parts to go into odd-ball devices. Many of these fellows are working on "secret" projects . . . they for because they're afraid that someone will swipe their idea. I do the best I can. We get our share of real cloak-and-dagger stuff, though. Any number of experts from the FBI, CIA and other agencies come in for components to build specialized devices. They know what they want their rigs to do, and they know what they need, but they can't tell us much about it. They get the VIP treatment, as opposed to the guy who comes in for "an oscillator or something to mess up my neighbor's TV set—it's so darned loud I can't sleep." The latter just gets a reading from the section of the FCC Regulations dealing with willful interference, and the penalties attached.

I try to be especially patient, and it takes a lot of patience, with the women who come in with a parts list from a son or brother or husband who's away in the Armed Forces, or in college, or on a job where there are no

parts stores. These gals think that they're shopping in Macy's where the customer is always right. We try to make things easy for them, and when they come back asking for an exchange or a refund, we act like the uptown department stores. The only time that we get really tough about refunds is when someone has obviously given a component a few whacks with a hammer to make it work.

I do have some gripes in this business. The Number One Louse is, of course, the know-it-all. He wrote the book, has a cellar full of gear and has all the answers. He comes into the shop just to browse around, make loud, disparaging comments on the merchandise, and bargain for a 10¢ pilot lamp. He frequently imposes his ignorance on an innocent bystander with, "Don't buy *that!* It's not what you want. And anyway, I know where you can get it cheaper."

Closely related is the customer who picks up an item and then tells me that he saw the same thing at Discarded Parts, Inc., for $3.00 less. Of course, that was three weeks ago, and now Discarded, our favorite competitor, is out of stock on that particular gadget. Speaking of competitors, it may be my imagination, but do my competitors make a special effort to send me *all* of their problems? And are these problem customers *always* in a tearing hurry because they're double-parked? Or does it just seem that way?

I get a little unhappy with the fellow who asks to see the Gold-Plated Gammatron which is in the most inaccessible part of the show window. After I've knocked over a box of 100 loose transistors, and stepped on a 4D32 in an effort to get it for him, he looks at it lovingly, says, "Gosh, I haven't seen one of these since I was in the Royal Navy in 1942," and walks out. At this moment the phone rings, and just as I'm saying, "Hello, Metro Radio . . ." a fellow barges in on my conversation to ask if I have any way of checking the 4X1000 from the final of his Super Cyclone Single Sideband Signal Shocker.

It may be a personal prejudice, but I haven't much patience with the self-styled ham who puts several thousand dollars into a completely commercially-assembled station, has it installed by a technically-minded buddy, and goes on the air to call CQ for 18 minutes before signing. Perhaps it springs from my own approach to ham radio, but I feel that such fellows are not really amateurs; they are just using their licenses to engage in some kind of high-powered Citizens Band operation.

I've given a lot of thought to this radio business, and I've often wondered whether the grass is greener on the other side of Radio Row. Television repair parts sell very well, and stereo hi-fi is going big. But, from my side of the counter, the kicks I get from the surplus business far outweigh the gripes. I think that I'd rather stay in a shop where a good number of the customers know more about radio than I do . . . where I can teach a little and learn a lot. One meets such interesting gadgets, and such interesting customers.

Transistor Biasing Simplified

Roy A. McCarthy K6EAW
737 W. Maxzim Ave.
Fullerton, Calif.

Applying the proper bias to a transistor circuit is admittedly slightly more complicated than biasing a similar vacuum tube circuit. As a matter of fact, the problems involved have no doubt caused many an amateur to become quite biased against transistors. It is hoped that this short conversion to amateur techniques of a few of the major problems involved will assist those who are really interested in using these little jewels.

A transistor is considered to be a current operated device. The obvious thing to do then would be to bias the "control electrode" with a source of fixed current, rather than fixed voltage. As usual, the obvious method proved to be wrong. In practice a little bug-a-boo called IcO changes the picture entirely, so that attempts to use a simple fixed bias current circuit, as shown in Fig. 1, resulted all too often in developing thermometers rather than useful amplifiers.

This IcO is the collector-to-base current, with the emitter circuit open. It consists of two major components, a thermally sensitive one which is mainly dependent upon the junction temperature, and a leakage current which is proportional to the applied junction voltage. In good quality small transistors the second component is usually insignificant, but in power transistors it may become the larger component of IcO at room temperatures. These two components of IcO can be broken down into more specific paths, but for practical work the methods of combatting the effects of IcO are more valuable than the detailed physics involved.

The simple bias circuit of Fig. 1 should not be rejected without at least giving it a try-

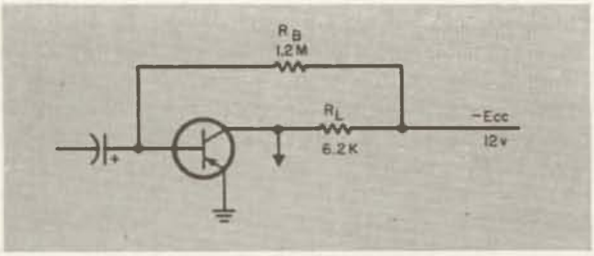

Fig. 1

out, if only to gain a better understanding of these little beasts. It is quite useful to the ham as a simple meter amplifier for wavemeters, or audio amplifiers where the bias resistor can be selected for the individual transistor in the circuit. The PNP transistor in Fig. 1 may have a typical IcO of 10 μA and Beta (ac current gain) of 50. As a starting point, most transistor amplifiers are designed for around 1 ma emitter current. The collector current will then also be nearly 1 ma, so that with a 12 volt supply, —Ecc, and a 6.2K ohm load resistor the collector voltage has plenty of room to swing with large signal voltages without clipping or bottoming.

To get this 1 ma of collector current we need a base current of 1 ÷ 50 ma, or 20 μa of base current. We already have 10 μa of base current supplied by IcO, so RB needs to supply only 10 μa additional, from the 12 volt supply. As indicated by the typical input characteristics of Fig. 2, the emitter to base voltage is negligible, so RB = 12 ÷ 10 x 10—6 = 1.2 megohms. Now what happens if the operating temperature of the circuit is

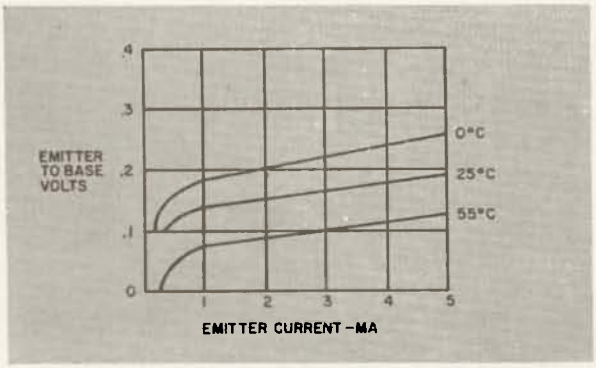

Fig. 2

increased about 10° C., or 18° F.? IcO doubles to 20 μa. RB still supplies 10 μa, so the base current is now 30 μa. The collector current now becomes 50 x 30 μa, or 1.5 ma, and the collector voltage drops to 2.7 volts. The circuit still works as an amplifier, and for small signals the effect so far may not be noticed, but a further increase in temperature, or changing to a transistor of higher gain, may cause saturation of the transistor and its refusal to function as an amplifier.

A slight improvement in the dc stability may be found in the circuit of Fig. 3a. By connecting RB to the collector instead of to —Ecc a bit of dc feedback is obtained which helps out by compensating for the increase of IcO with temperature. As the collector voltage tends to drop the base current supplied by RB also decreases. Unless the collector is capacitively coupled to a low impedance ac load, this circuit may also result in ac feedback which reduces the available ac gain. One method of preventing this is to split RB in two equal parts, as in Fig. 3b, and bypass the ac feedback signal with a capacitor. For radio frequencies this may not be necessary, since the input capacity of the transistor may be sufficient to cause the input impedance to be very low compared to RB.

In Fig. 4 is shown the usual method of biasing individual low power amplifier stages. Although it is only slightly more complicated than those previously discussed, it offers tremendous advantages in improved dc stability and ease of predicting its performance with normal variations in temperature or transistor characteristics and circuit components. Calculation of the exact value of each resistor for a given Stability Factor can of course be quite involved, and the same goes for working out the optimum values for best performance. However, as amateurs who work in engineering labs may have noticed, optimum final design is normally based upon experimental verification, more commonly known as "cut and try." Simply picking the values of the components from any commercial circuit may result in a usable amplifier, but one which is over-designed for amateur work. So, it might prove profitable to see what factors influence the selection of components.

The emitter bias resistor, RE in Fig. 4, provides a considerable amount of negative current feedback. Hence, any tendency for the emitter current to change is compensated for to a large degree. In addition, RE is generally large compared to the resistance of the emitter to base junction, and so prevents changes of the base to emitter voltage from affecting operation. Selection of the value of RE is more generally an intelligent guess, rather than a mathematical calculation. Too high a resistance would cut down the available collector to emitter voltage, which would limit the ac signal voltage swing. Too low a resistance would make it necessary to use a low value of RA for good dc stability, and this would shunt too much of the signal, reducing the gain. Typical values for RE are 1K ohm for general purpose amplifiers, 2.4K for low noise preamps where the normal emitter current may be ½ ma and 470 ohms for low level driver stages.

The base resistor RA is usually made 3 to 10 times the value of RE. A smaller value will provide better dc stability, but a higher value results in less signal loss due to shunting the input. In Fig. 4, we chose to make RE 1K ohm, and RA 3.6K ohm with an emitter current of 1 ma. These values should give

good stability even out in the desert in midsummer. The 1 ma through 1K puts the emitter 1 volt above ground, and the base a little more than 1.1 volts above ground; picking the emitter to base voltage from Fig. 2. RB then can be readily calculated. The current through RA, and also RB, is 1.1 V ÷ 3.6K = .31 ma (neglecting IcO). RB is then 12 V − 1.1 V ÷ .31 ma = 35K ohms. A 36K resistor will do as well.

Since we had 1 ma of emitter current, and nearly 1 ma of collector current, a 6.2K ohm collector load resistor will set the collector voltage at slightly below the half way point. We lost one volt in the emitter resistor so the supply voltage is now 11 volts, rather than 12. A more optimum bias level would call for a lower load resistor, but this would lower the amount of signal available to a following

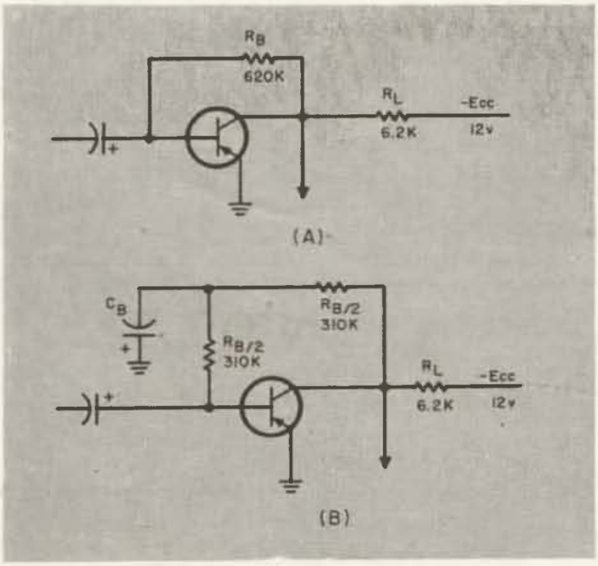

Fig. 3

stage, since the collector load and the input circuit of the following stage are effectively in parallel as far as the signal is concerned.

Up to now we have ignored the coupling capacitor, Cc, and emitter bypass, CE. The coupling capacitor is generally chosen so that its reactance, at the lowest frequency to be amplified, is small compared to the sum of the generator or source resistance and the input impedance of the amplifier. In a multistaged amplifier Rg is of course the collector load resistance of the previous stage, since it is usually very low compared to the transistor's output impedance. Typical values for Cc in the audio range are 1 to 10 mfd. Since these are usually low voltage electrolytics, the polarity must be carefully observed.

As with vacuum tube circuits, CE should have a very low reactance compared to the value of RE over the range of frequencies it is desired to amplify. But, unlike vacuum tube circuits, the low frequency cut-off point, at which the response is 3 db down, is where the reactance of CE times Beta is equal to the source resistance. In this case the source re-

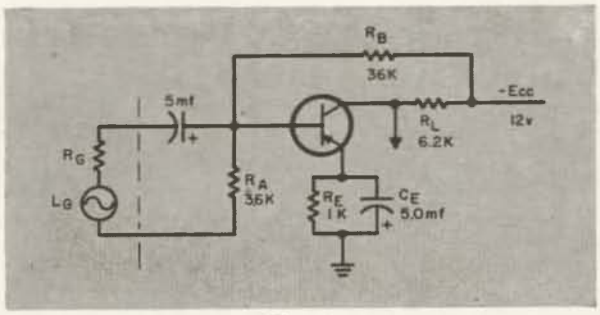

Fig. 4

sistance is Rg in parallel with RA and RB. Typical values for CE are 25 to 100 mfd for audio.

Now that we have worked out an amplifier, as in Fig. 4, even though it might not be quite as well designed as could be done by a more rigorous mathematical treatment, it might be interesting to see if we could estimate its useful gain. We started with a typical transistor with IcO of 10 μa and Beta or hfe of 50. An additional parameter of interest would be the common base input impedance, hib, which is approximately 30 for typical audio units. If it isn't given, it can be readily calculated from the formula: hib = hie ÷ (1 + hfe), where hie is the common emitter input Z.

The voltage gain is then readily approximated by the formula: Av = R1 ÷ hib, and therefore in this case it is 6,200 ÷ 30, or around 206. If the amplifier is loaded down by a following stage the R1 used in the formula would be the sum of the collector load resistance in parallel with the input impedance of the next stage as well as any biasing resistors connected to that stage. The same applies to the current gain, which in an unloaded stage is equal to Beta. However, the lower the input impedance of the next stage, the more the available current gain is used, whereas the voltage gain is reduced. Since transistors are current amplifying devices, reduction in voltage gain is not much of a loss.

The dc gain was cut down so much by this amplifier configuration that it really isn't worth wasting time calculating the stability factors, except perhaps for practice. For those who are game to carry on a couple of excellent references are listed below. Naturally, this short an article couldn't begin to cover all the intricate aspects of transistor biasing. In addition, considerable liberties were taken in using approximations with the calculations. Nevertheless, the procedure outlined will result in perfectly usable amplifiers, and assist in gaining further insight into the workings of these mysterious little trinkets.

. . . K6EAW

References: Transistor Electronics; Lo, et al, Prentice Hall, Inc.
Transistor Circuit Engineering, R. F. Shea, John Wiley & Sons.
General Electric Transistor Manual, 5th Edition, G. E. Co.

Power-house Pros

Last month, in Part One of this article, we discussed basic power supply circuits, filters, and voltage multipliers. While they're important, they're only the starting point toward a power supply which is designed rather than tossed together out of the junk box. Let's see what's on down the road. . . .

Staff

A basic power supply, consisting of an input power source, a rectifier circuit, and a filter, is capable of operating any electronic device. However, its operation can be improved tremendously for many purposes by incorporating additional circuits and by using the more-familiar circuits in different ways. While these additional circuits are admittedly the frosting on the cake, some kinds of cake are completely flat-tasting without any frosting at all.

The most familiar of these extra circuits is the voltage regulator. Like the term "power supply" itself, this name actually describes a number of different circuits. All have the same purpose: to hold output voltage constant under varying load. This can be accomplished

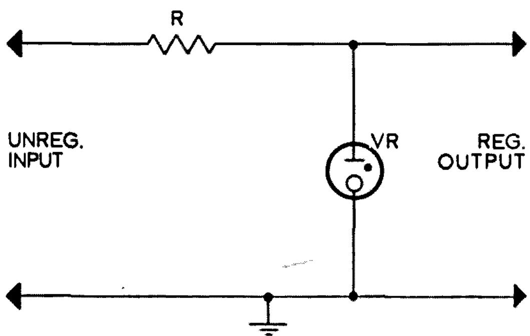

Fig. 1

with active or with passive elements (or, more frequently, with a combination of both.)

Most of us are familiar with the simplest voltage-regulator circuit, which employs a special type of cold-cathode gas discharge tube called (oddly enough) a voltage regulator tube. This tube makes use of the fact that voltage drop across a normal-glow gas discharge tube is almost constant within rather wide limits, and that value of this voltage drop is established in design of the specific tube.

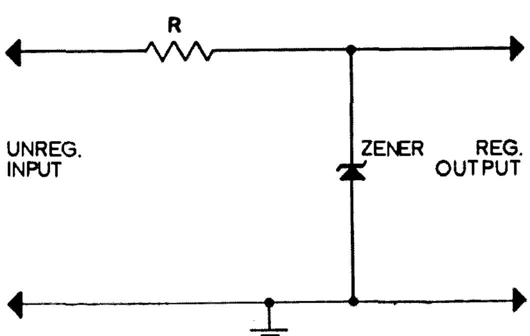

Fig. 2

In use, the tube is connected in series with a current-limiting resistor as shown in Fig. 1, and output is taken in parallel with the tube. VR tubes are normally available in 90-, 105-, and 150-volt ratings; other values are obtained by series connections.

To understand circuit operation, imagine that the tube is actually a variable resistor whose resistance is controlled by the voltage across it. As voltage drops, the resistance rises, tending to keep voltage constant by divider action.

VR tubes are not the only circuit elements which behave this way. An ordinary neon glow tube exhibits exactly the same effect, although at a different voltage level (which varies from tube to tube) and at much lower currents.

One of the main disadvantages of the gas-tube regulator is that output voltage is fixed at one of the design values or a combination of the few available voltages. Another element which acts in an identical manner for different reasons overcomes this difficulty, since it is manufactured in a wide range of voltages: the Zener diode.

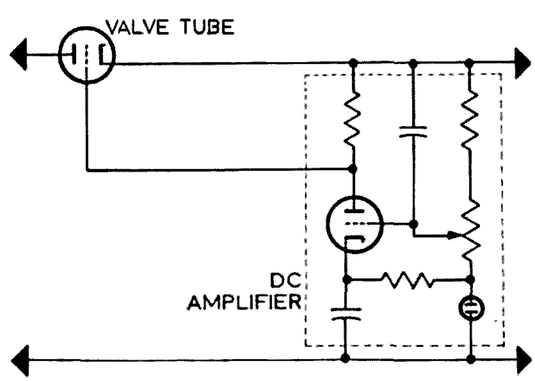

Fig. 3

The Zener diode is a specially-processed type of silicon diode which also exhibits constant voltage drop under certain conditions. As can be seen from Fig. 2, the circuit is identical to that of a gas-tube regulator with the diode replacing the gas tube.

However, Zener diodes are available in voltages from 3.9 volts up to 150, at prices ranging from 44 cents (for an economy line put out by Hoffman) to many dollars (for high-wattage industrial-type units). Since they don't burn out with use as tubes do, the approximately doubled cost is actually less expensive in the long run.

Both the Zener and the gas-tube circuits can regulate output voltage to within 1 percent

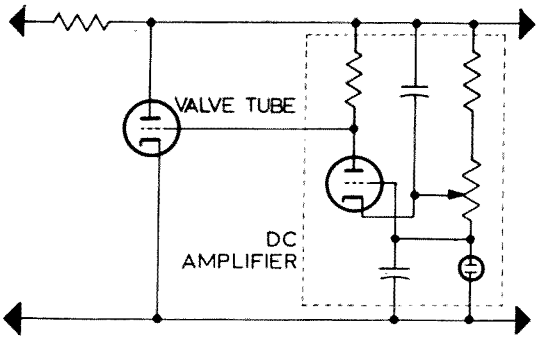

Fig. 4

for varying loads or for input voltage changes, but frequently regulation must be even closer than that. An example is the oscillator voltage supply for an FM rig, or for a high-selectivity SSB receiver. Voltages here should be regulated to much closer than 1 percent stability.

Regulation of this type demands an active regulator, rather than the passive types described so far. Such a regulator is shown in Fig. 3.

This circuit uses a high-current, low-voltage vacuum tube as a series valve. Resistance of the tube is determined by its grid-cathode voltage, which in turn is controlled by the dc

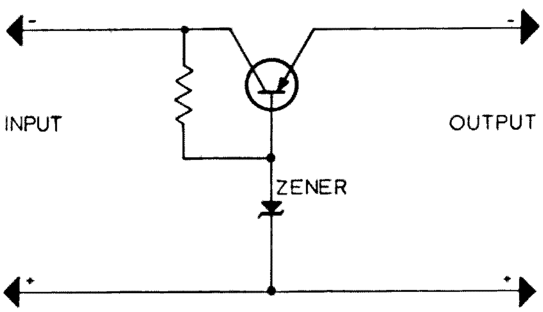

Fig. 5

amplifier circuit shown enclosed in dotted lines. The dc amplifier compares a selected portion of the output voltage to the voltage of a passive standard, and adjusts the valve tube's bias accordingly. With a high-gain dc amplifier, this circuit can maintain output voltage constant within 0.01 volt for 10 percent variations in input voltage, from no-load to maximum-load conditions. It also provides instant adjustment of output voltage value by means of the potentiometer, which determines what portion of output voltage is fed to the dc amplifier.

Another circuit providing close regulation and adaptable to higher current is that of Fig. 4, which uses the vacuum tube as a shunt element (replacing the VR tube in the circuit of Fig. 1). In operation, resistance of the control tube is varied by the dc amplifier in the same manner as for the circuit of Fig. 3 (but with opposite polarity), and the control tube

(Turn to page 50)

then varies output voltage to keep the output value constant.

Similar series- and shunt-type regulators can be built using transistors (Fig. 5 and 6) and operate in the same manner. Engineers at Motorola have built such a supply to deliver more than a kilowatt at up to 30 volts, for test purposes, and report regulation within a quarter-volt from no-load to full-load conditions.

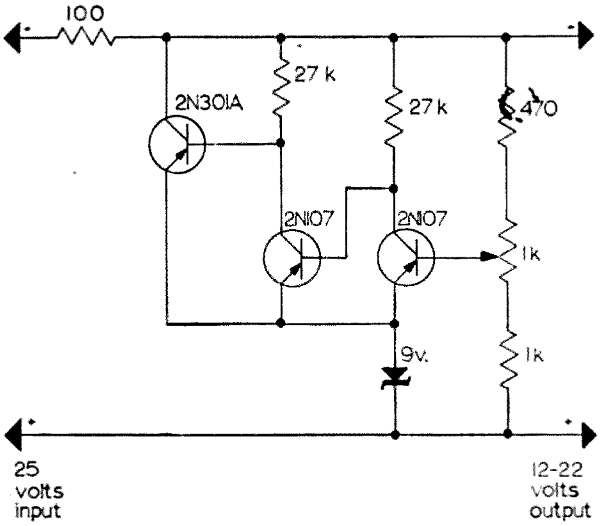

Fig. 6

All these active circuits employ feedback to reduce "error" voltage to something approximating zero; feedback can also be used to eliminate heavy filter chokes from a power supply without loss of performance. The circuit is shown in Fig. 7.

In operation, the input voltage has a strong ac component which is coupled directly to the grid through a capacitor and to the cathode through a resistor. Screen voltage is filtered through an RC filter. The variable resistor is adjusted so that the tube's series resistance is low except when the grid receives a negative pulse at the top of the input waveform. At this time, tube resistance rises. The property of

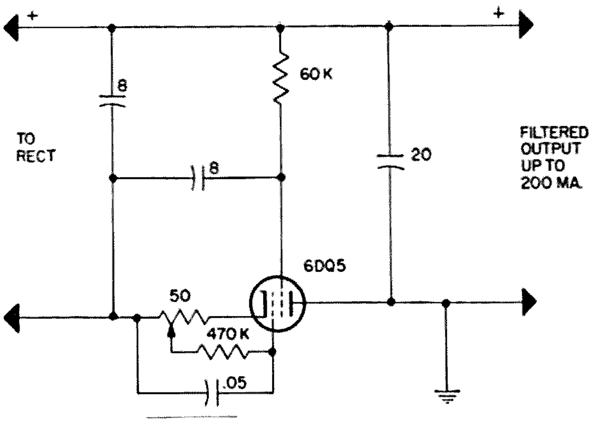

Fig. 7

rising impedance with increasing current characterizes inductance, making this circuit interchangeable with a choke in any power-supply application. In practice, less voltage is lost across the tube than across a choke for the same load current value.

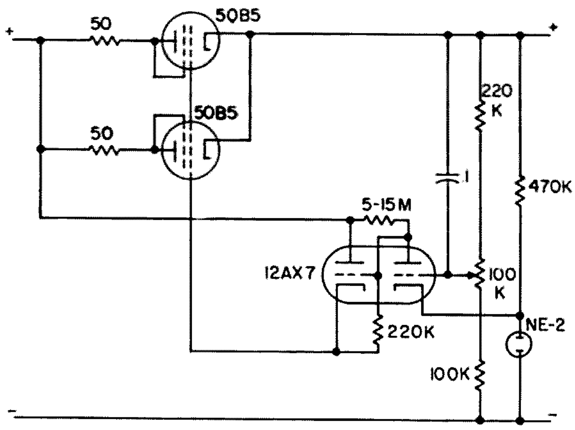

Fig. 8

Dozens of construction articles on power supplies for various purposes have been published; they include variable-voltage units for

(Turn to page 52)

Letters

Dear Wayne,

Another fine issue of 73! You sure have it "at both ends," both fine articles and interesting ads.

If you're interested in more subscribers (hi) you might try sending one copy of 73 to the president of some of the many radio clubs around the country and including a circular on the magazine giving more information including individual and club rates. If you don't have a list of some of the clubs across the nation you always could include a blank along with your next reader's poll.

I thought that I'd pass along some handy information for the VHFers who "roll their own." Discarded televisions are easily available in most sections of the country, either from neighbors or from television dealers who cart them off while installing new models. Besides having a great number of good tubes, a useful power supply, and other goodies, the tuner invariably contains coils for the various channels which can easily be converted to use on the VHF bands. First check the capacitor in parallel with the coil and determine the inductance of the coil using the **Handbook** formula and the **Handbook** table for television channel frequencies, then calculate the capacitance required to resonate the assembly in the desired band, add the capacitance, and presto, you're in business.

Channel Two and Three coils work best on six meters, while those for channels six and seven perform best on two meters. Because of the six mc bandwidth of the tv channels, the coils perform admirably in broadband converter circuits.

Would you by any chance be interested in publishing an article on a control unit that I am working on that incorporates an ultrasimple, but effective conelrad monitor, a selective audio filter for code, complete power fusing and control, a T-R switch, and a code monitor? This unit is entirely non-critical and can be adapted to ayone's junk box.

. . . Kenneth Hirsch K9TMB

Well Kenneth, I sure would like to send a copy of 73 to club presidents, but the problem is one of time. This magazine is snow-balling so fast I don't even have time to answer much of my mail, much less start more going out. I know everything would go faster, but it still isn't possible. Of course if I could round up a few more fellows to lend a hand with the work we might get things speeded up, but I find that enthusiasm wanes when I answer the salary question by offering them the same pay that all of us on the staff are getting. Your control unit might be of more interest for the parts: your audio filter, if it is different, would be of great interest and would be an article in itself. Ditto the T-R switch and code monitors. Conelrad monitor? Bah! . . . Wayne.

Dear Wayne,

You remember that fabulous little KW mobile linear built **in-the-antenna**, with midget water-cooled Eimac final, Jennings vacuum capacitor, and midget inverter supply in the car? W6TMG, the fellow who was producing it at Yuba Dalmotor Division, has moved over to the Electro Mechanics Division of Cabral Motors, with all the goodies hamwise, and is in addition taking over production of the D. Moore SSB Transceiver and putting it out wired and tested for under $100. The rig is now called the Mark 2B, and a matching 100-watt linear is now on the planning boards. Thought you might like to know, since W6MHP was swamped with orders for this rig even without overt advertising of any kind. However the full dope will probably now appear in an ad somewhere around this end of the magazine.

Jim WA6EXU

(Power from page 50)

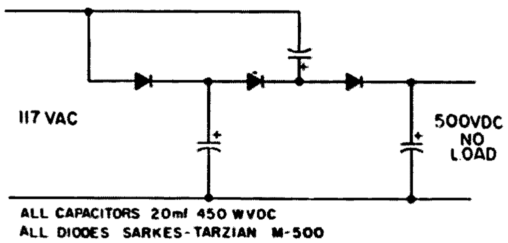

Fig. 9

bench use, high-power units to supply several items of equipment at the same time, low-ripple units for powering transistor equipment, and a host of other special-application circuits. Some of the more-interesting ones from a general-application viewpoint are described in the following paragraphs; many others are included in the bibliography at the end of this article.

Among the most-interesting circuits described in the past 5 years are the Minipacks developed by Rob Wagner, W6WGD. Delivering approximately 150 volts at up to 50 ma., they're ideal for powering a VFO or other small station accessories.

The basic circuit of the two versions of Minipack is a voltage regulator of the series-valve type using two 50B5's in parallel. The dc amplifier is a 12AX7. Filaments of these tubes are connected in a series string across the ac input. Using a neon tube as the voltage reference, output is held within 1 percent over the range from 75 to 175 volts.

One version uses a conventional center-tapped full-wave rectifier, the other a voltage doubler. Since the regulator is the heart of the circuit, it alone is shown in Fig. 8. Due to small sizes of the components, it can be built on a 2x2x5 chassis box.

Another tiny supply with a wallop is that shown in Fig. 9, adapted from a similar but larger circuit in the Handbook (1959 edition). This complete unit develops 500 volts without load and more than 300 volts at 200 ma output, yet occupies a space only 3x5x1½ inches complete. Basically, it's a half-wave tripler using medium-large capacitors. Filtering action of the three capacitors shown is adequate for normal receiver use, but for powering low-level audio stages a simple RC filter (shown in dotted lines) should be added to minimize hum.

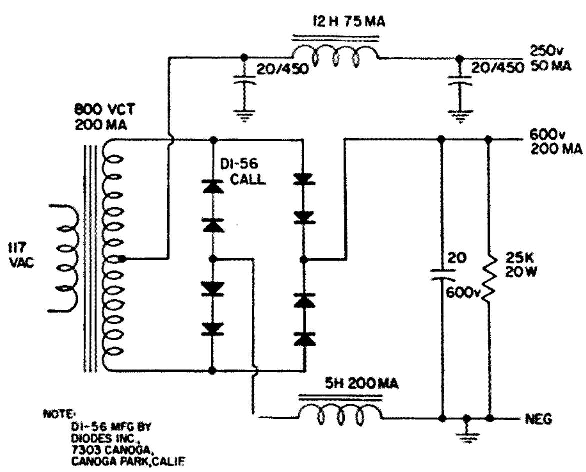

Fig. 10

With present-day silicon diodes, we can go even smaller in size. The circuit of Fig. 10 was originally described in GE Ham News, and adaptations of it have appeared in several publications since. It's basically a normal bridge-type rectifier using miniature silicon units (less than ⅛ inch in diameter and ¼ inch long) instead of vacuum diodes or more-conventional selenium rectifiers.

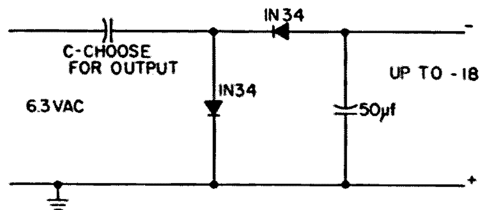

Fig. 11

Many of the newer receiver circuits require a bias voltage, which is seldom provided by an existing set's power supply circuits. Since this bias voltage is usually supplied at low current, hefty savings can be made by using inexpensive 1N34-type diodes in voltage-multiplier arrangements off the 6.3-volt filament line, a la Fig. 11.

If bias requirements are less than —9 volts, the shunt diode bias supply shown in Fig. 12 may be added easily to any receiver. It was originally described in the Radiotron Designer's Handbook for use with a vacuum diode, and has been converted here to use a semiconductor instead. Any semiconductor diode is satisfactory.

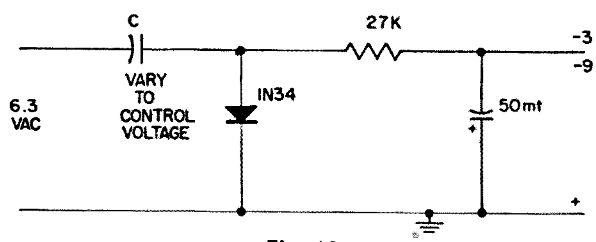

Fig. 12

Especially for experimentation, it's frequently nice to have a power supply on the bench which has continuously variable output. While this can be achieved either by using a hefty rheostat in a conventional voltage divider or by using an active-regulator circuit, an English circuit developed by A. H. B. Walker and described eight years ago by William Creviston in Radio & Television News offers a simpler approach.

The basic circuit uses audio power output

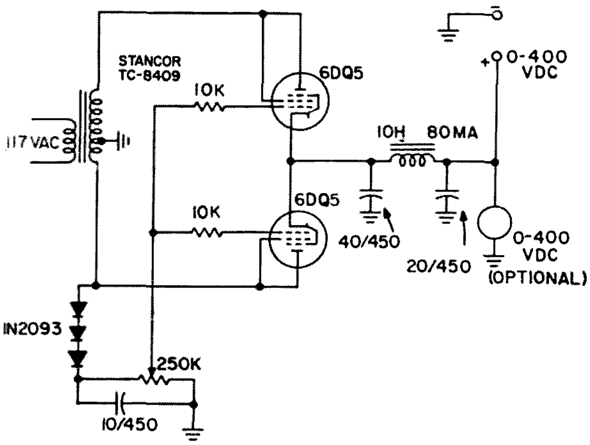

Fig. 13

type as rectifiers in a conventional center-tapped full-wave circuit. However, the grids of these tubes are returned to a variable bias source which is controlled from the front panel. Output voltage cannot be greater than grid voltage, and as a result the low-power bias supply controls the much greater output power of the main unit.

As shown in Fig. 13, the circuit has been adapted to use the high-perveance TV horizontal-output tubes which didn't exist when the circuit was developed. With constants as shown, output ranges from 0 to 300 volts at up to 250 ma. All parts values are uncritical, as are tube types.

A similar type of variable-voltage power supply, widely described, makes use of a type of rectifier we haven't yet discussed—the gas diode. Actually, in the variable-voltage design, a gas triode is used instead of the diode, but before we examine the circuit, let's detour a bit and compare gas rectifiers to the more-ordinary type.

The most common type of gas diode is the familiar mercury-vapor tube, such as the 866 for high voltage or the old type 83 for lower-power applications. They're distinguished in operation by a fluorescent blue glow inside the tube.

Principles of operation of the mercury-vapor tube are similar to those of a vacuum diode in many ways; electrons are emitted from the hot cathode, and are attracted to the plate only when the plate is positive. However, the M-V tube is filled with gas, and as the electrons move through the gas they ionize it.

The positive ions produced as a result nullify all space-charge effects, which in a vacuum diode limit the amount of current available. The "plasma" in a M-V tube or other gas diode is actually a near-perfect conductor so long as the gas is ionized.

Because of this near-perfect conduction, the voltage drop in an M-V tube is much lower than that in a comparable vacuum diode. However, this advantage carries a built-in disad-

(Turn to page 54)

(Power from page 53)

vantage, similar to one requirement for semiconductor rectifiers: a current-limiting resistor is a must when using an M-V rectifier. Otherwise, the tube may run away with itself and be destroyed.

In addition, operating temperatures are more critical, since both the ionization and the allowable reverse voltage are determined by gas pressure within the tube, which in turn is determined by the tube's temperature.

In summary, the M-V diode offers lower voltage drop and higher current capacity than does a comparable vacuum diode. It can also be built with higher reverse-voltage ratings, and for this reason is popular in high-power circuitry.

With the gas diode sketched in, let's look at the gas triode—or to give it its more common name, the thyratron.

A few paragraphs back we mentioned that the gas in an M-V tube is ionized by motion of electrons through it. It follows naturally that if no electrons are allowed to flow, no ionization can occur, and the conducting "plasma" won't be formed.

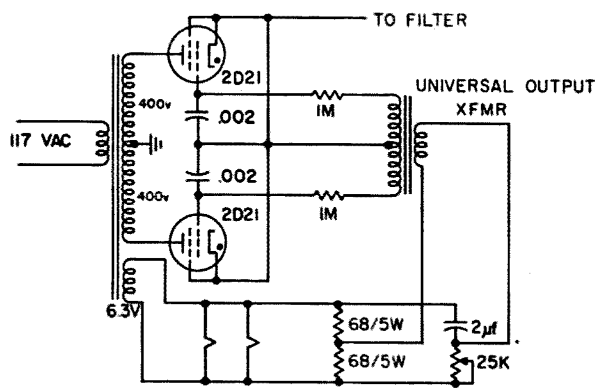

Fig. 14

A structure in the thyratron called the "grid" by analogy (it doesn't look at all like a grid) does just this. If, with plate voltage off, the grid is made extremely negative, no current can flow even with plate voltage applied. So far, this is similar to vacuum-triode action.

However, in a vacuum triode, the grid acts something like the handle on a valve; plate current can be turned on, then can be controlled in intensity, and finally can even be turned off again, all by the grid's action.

In a thyratron, the grid is more like an explosive charge. It can be fired to "blast loose" ions and initiate an avalanche of plate current, but once it has been fired it loses all control until plate current is once again turned off externally.

This might seem useless were it not that plate current in a rectifier tube is turned off externally at least 60 times every second, whenever the ac supply goes negative. This restores control to the grid at the same rate.

Now, by arranging things so that the grid is completely negative whenever the plate is positive, plate current can be kept at a minimum. On the other hand, if the grid and plate both go positive at the same time, current flow will be at a maximum. And if the tube firing point is somewhere in between, plate current will flow in a series of short pulses which add up in the filter to less-than-maximum power output. With a fixed load resistance, the variations in current and power are automatically transformed into changes in output voltage.

This means that if we have some means of controlling the firing point of the tube within each cycle of supply power, we have a ready control of output voltage no matter how high that output voltage may be. Note that there's no regulation; simple control is the only thing we're gaining here.

One way to accomplish our end is to vary the relative phase of grid and plate voltages by an adjustable phase-shift network supplying the grid voltage. That's the way it's usually done. The phase-shift network is composed of the capacitor and variable resistor in the primary of the grid-power transformer, T2, in the circuit of Fig. 14.

If you like to experiment, you might blend this circuit and the active regulator of Fig. 3 together by using the DC amplifier output of the regulator to control resistance of a vacuum tube, which would in turn replace the variable resistor of Fig. 14. Such a circuit might extend regulated-supply operation into the high-power classification at minimum expenses—and it might cost you a power supply. It hasn't been tried to our knowledge, and is mentioned here only as a suggestion to the experimenter.

So far, we've talked only of power supplies which convert electrical input power into electrical output power having different characteristics. Naturally, batteries, solar cells, and the like can also be considered as "power supplies" but have been deliberately omitted from the discussion. However, before closing we want to describe a unique power supply which might be classed as a "vacuum thermocouple," a special form of vacuum rectifier, or maybe just a useful oddity.

This is the contact-potential supply developed and described by Hubbard in several articles over the years. A typical circuit for such a supply is shown in Fig. 15.

This may look a bit odd to anyone familiar with conventional power supply circuits, but we can verify that it works. Here's what happens:

When the rectifier cathode is heated, electrons boil off and form a space charge surrounding the cathode. Even with no potential applied to the plate originally, a few of the electrons punch through the space charge and reach the plate.

With the plate open-circuited, the few elec-

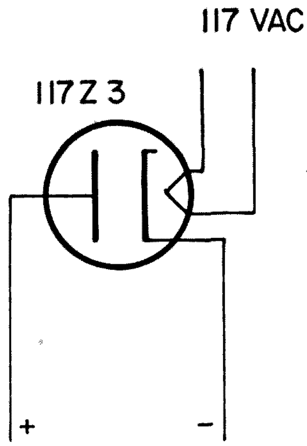

Fig. 15

trons which punch through have no place to go and the plate is almost immediately made too negative to accept more. However, if a high-resistance load is connected from plate to cathode, the high-pressure electrons can flow through the load back to the cathode.

Output is as close to pure dc as you can get, since it is unaffected by power-supply frequency. While it's true that power is almost microscopic (less than a volt at one ma for most tubes) it's plenty to operate transistors, and will even power a vacuum-tube oscillator to several microwatts output at audio and low radio frequencies. Certainly no simpler supply for low-voltage transistor projects can be made; using a 117-volt tube means that all you need is the tube, a socket, and a line cord; no filter or other circuitry is required.

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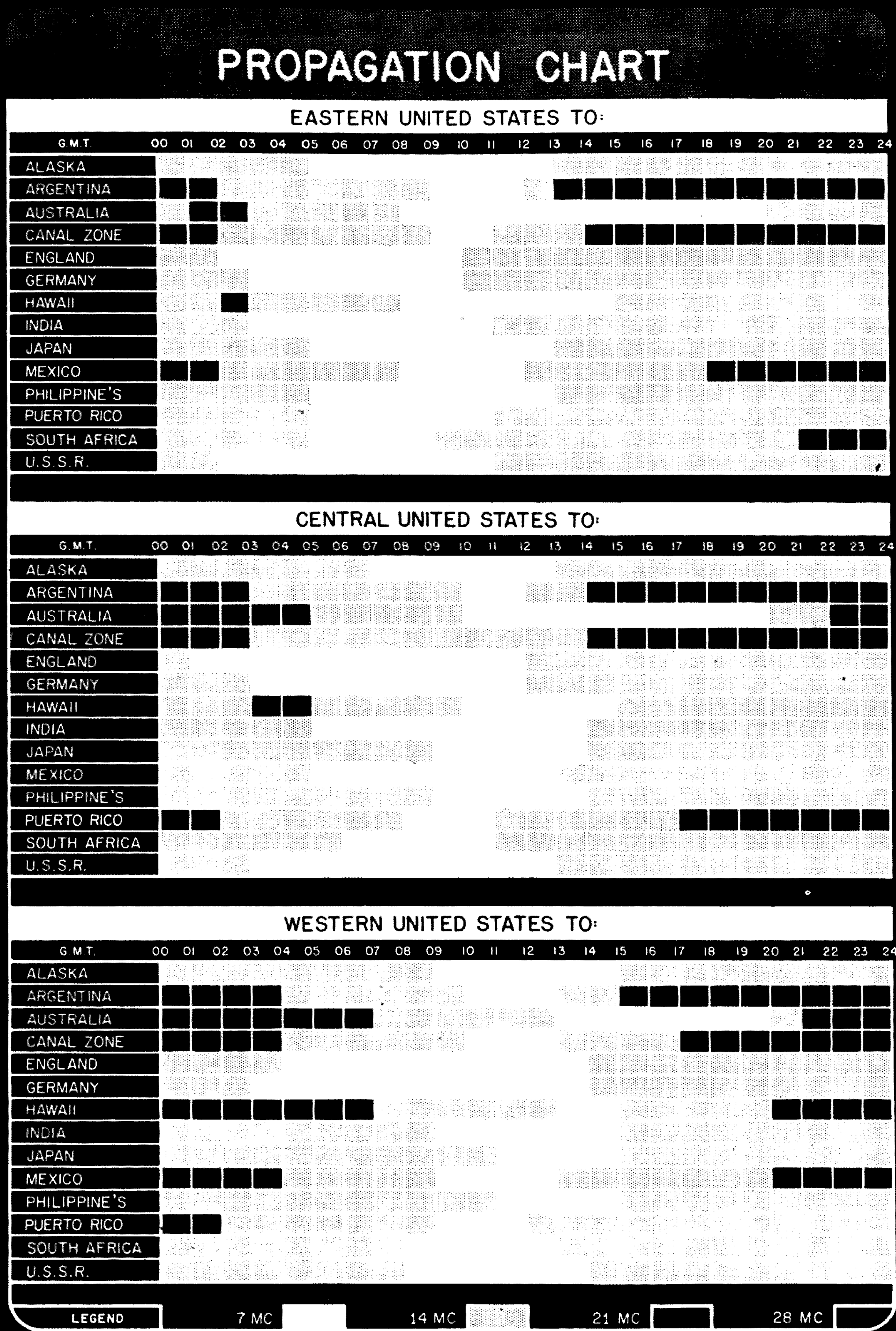
PROPAGATION CHART
EASTERN UNITED STATES TO:
G.M.T.
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PUERTO RICO
SOUTH AFRICA
U.S.S.R.
CENTRAL UNITED STATES TO:
G.M.T.
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
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SOUTH AFRICA
U.S.S.R.
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JAPAN
MEXICO
PHILIPPINE'S
PUERTO RICO
SOUTH AFRICA
U.S.S.R.
LEGEND
7 MC
14 MC
21 MC
28 MC

Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

The bands listed are MUF's and a higher band will not work for the time period listed. Lower bands will work, but not nearly as well. Times are GMT, not local time.

These charts are to be used as a guide to ham band openings for the month of July, 1961 to the various countries listed. I will be interested to hear of your results in using these charts and to know what other areas you might wish included in future charts.

Advanced Forecast: July 1961

Good 1-3, 7-19, 26-31

Fair 4-6, 20-25

Bad None

Zero Center Meter For RTTY

Most ham junk boxes contain a few meters, but if you are a newcomer to RTTY they are not likely to have a zero center. Before you rush out and "pay the shot," or look for one in surplus, do a little reconnaissance inside those that you have and you may discover that you can adjust one to have a zero center.

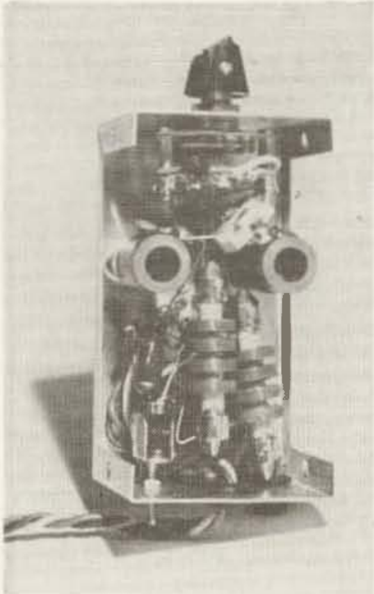
Meters usually have a lever, actuated by a screw on the face of the meter, to set the needle to its usual spot at zero. This lever does not have enough range to put the needle up to center scale. However on the opposite end of the needle shaft there is another lever, the one to which the needle return coil spring is attached. If this lever can be moved carefully to the left without interfering with the rest of the works, the needle will move upscale to the desired center spot.

Remove the scale, turn it over and spray with several coats of white lacquer, and let it dry thoroughly. Now with a drafting compass and India ink, draw a heavy arc which is the same length as the original meter scale. At the center of the arc draw a short vertical line to represent the meter zero.

The meter may now be reassembled, and the regular zero adjusting screw used to put the needle right on center. The meter action may be checked by setting up a series circuit with a rheostat and a flashlight battery. The needle should deflect an equal amount in each direction when the polarity is reversed.

An old Jewell meter as well as a surplus British O-.5 amp thermocouple meter (basic O-5 ma movement) responded to this treatment. Remember that most meters, despite what it says on their scales, are basically milliameters and are fair game. Several Weston meters that we looked into defied adjustment, but then, one really shouldn't tamper with the family heirlooms.

For use with an RTTY converter, it is not necessary to calibrate the scale, however the meter should be properly shunted to read full scale in either direction when the desired current is flowing. . . . W2BZN



Band Edge Marker

A. DePascale K1NFE
125 Queen Street
Bristol, Connecticut

How many times have you said, "I think I'll save this piece of junk; some day I may have use for it!" I certainly have and I've got a cellar full of stuff to prove it!

Several weeks ago, in the box marked miscellaneous, I found an old 3500 kc crystal which had been removed from a BC-696 Command transmitter. The crystal is housed in a tube-like enclosure, and is mounted on a standard octal plug base. Then it hit me! Why not use this crystal for a simple band-edge marker. Harmonics of a 3.5 mc crystal are conveniently located at 7, 14, 21, and 28 mc—how nice!

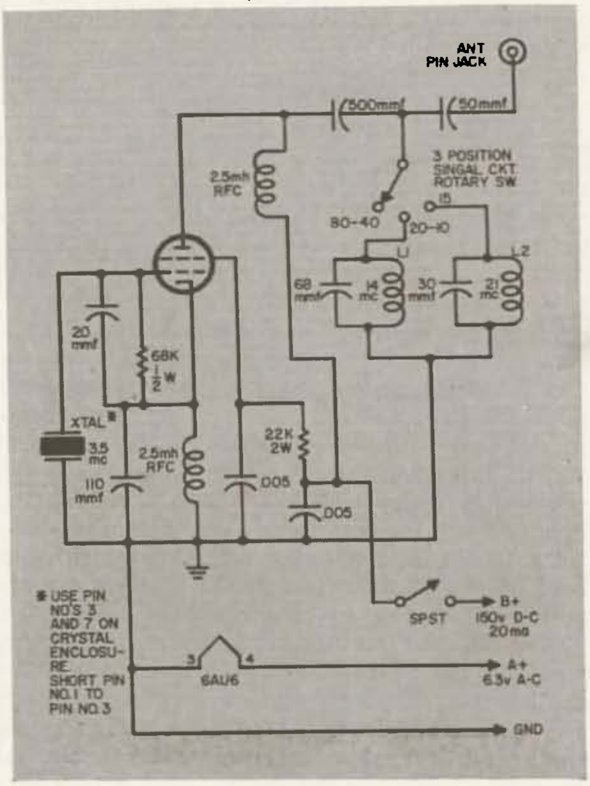
Now, refer to the circuit diagram, the photographs, and the parts list. A 6AU6 was used as the oscillator tube in my particular unit, but almost any screen-grid pentode of this type should work satisfactorily. A Mini-Box was used to house the components, and the parts layout is not critical. The slug-tuned coil forms were stolen from an old TV set and rewound for 14 and 21 mc with the help of a grid-dipper. The fundamental frequency and the second harmonic of the oscillator are strong enough so that tuned plate circuits are not necessary on 80 and 40 meters. LI is tuned for 14 mc, and the band switch should be in this position when using the unit on 20 and 10 meters. L2 is tuned for 21 mc, and the band switch should be in this position when using the unit on 15 meters. With the band switch in the first position (80 and 40 meters), harmonics of the fundamental frequency *will* be heard on all bands, but they are rather weak on 20, 15, and 10 meters. For this reason, tuned plate circuits are switched in for operation on the higher frequencies.

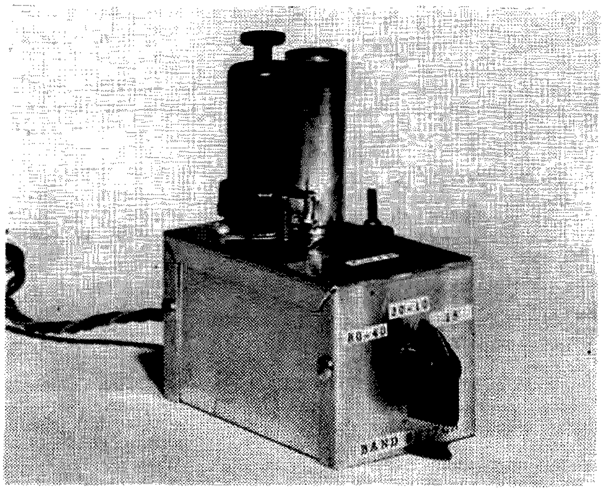
During the construction of the unit be sure to short pins 1 and 3 on the octal crystal socket. This will allow the unit to be used for testing crystals that have a standard FT-243 base.

Operation

The unit requires about 150 v dc at 20 ma, and 6.3 v ac at 300 ma. Most communications receivers will supply the necessary additional power for the unit. Many of the receivers on the market have an accessory socket to which the unit can be connected.

With power applied to the unit, and a piece of wire in the antenna pin jack, set the receiver dial to 3.5 mc, and move the band switch





to the 80-40 meter position. The oscillator signal should be heard in the receiver (don't forget to turn on the BFO). Tune the receiver to 14 mc, move the band switch to the 20-10 meter position, and adjust L1 for the loudest beat note in the receiver, or turn the BFO off and use the receiver S-meter and tune L1 for maximum deflection. Tune the receiver to 21 mc, move the band switch to the 15 meter position, and adjust L2 for maximum S-meter deflection (or loudest beat note). If the oscillator signal appears to be weak, add a few inches to the oscillator antenna, or wrap the oscillator antenna around the receiver antenna lead (use insulated wire).

Of course, you dont' have to use a Command set crystal in this unit. Any 3.5 mc crystal will work just as well. With a collection of parts on the table it only took me one evening to build this unit, and it certainly is a worthwhile (and inexpensive) addition to any amateur station.

Parts List

1—Mini Box, 2¼"x2¼"x4"
1—Octal Socket
1—7 Pin Min. Socket (Shielded)
1—3 Term. Mounting Strip
1—Pin Jack
1—½" Rubber Grommet
1—SPST Toggle Switch
1—3 Pos. Single Pole Rotary
1—20 mmfd 100 v dc
1—110 mmfd 100 v dc
2—.005 mfd 300 v dc
1—50 mmfd 300 v dc
1—500 mmfd 300 v dc
1—68 mmfd 300 v dc
1—25 mmfd 300 v dc
1—68K, ½ Watt
1—22K, 2 Watt
2—2.5 mh rf Choke
1—6AU6 Tube
2—½" Slug Tuned Coil Form
1—3500 kc Crystal
1'—#16 Enamel Covered Wire
L1—12T #16 enam. close wound
L2—7T #16 enam. close wound

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(W2NSD from page 6)

If you are much of a short-wave listener you have a rough idea of what the results of this program would probably be: an exposure of the shameful waste of frequencies that is the result of our present allocation system. There are thousands of transmitters on the air day after day just holding down channels or running up log time to prove the need for the frequency. There are hundreds more devoted to jamming attempts at international broadcasting. The wastage is incredible. Can anyone say with a straight face that the solution to this is to take frequencies away from the amateur and turn them over to commercial or government use? Bah!

With some facts and figures we might be able to bring some sanity into this jumble. If you don't like this suggestion, then how about you're thinking up something better? I recognize that many government groups will be against this idea . . . they are in the middle of a terrible situation and are trying to live with it on the present system of allocation . . . ditto commercial groups. Though everyone would gain in the long run from an investigation of the actual traffic use of the short waves, everyone but the amateurs would be faced with the facts and figures on their folly and the pressure would be on to solve this enormous waste. It is always easier to take temporary expedients than to make overall changes, so we can expect vigorous resistance to anything we propose from many quarters.

If nothing else, this is something to think about and maybe give an airing on a roundtable. Give the weather a rest.

Pay Our Way?

The WA2 calls have been unwinding at quite a rate as ham radio expands into every corner of New York and New Jersey. The FCC must indeed be working full time to take care of this flood of new licensees. As the calls unwound I got to thinking more and more how desirable one of those WA2 calls would be. As a matter of fact there is one that I would trade in my well worn W2NSD to get . . . heh, heh!

So I called them just to make sure that there was no hope of getting the coveted call. There wasn't. As a matter of fact they go out of their way to make sure that fellows won't get a call that might look like favoritism. So died my hope of getting WA2YNE (the two is silent). Sigh.

While talking with them I asked about some other problems that had been bugging me . . . such as allowing fellows to take the Tech exam

under FCC supervision, etc. The difficulty with this is the personnel that it would take and the costs. Which brought up the subject of our footing the bill for our own licenses. This makes sense to me, but then I would probably be a Goldwater Republican if I were interested much in politics. The present governmental system irritates me . . . too damned big with department built on department. Undoubtedly I am naive, but I firmly believe that they could send 50-75% of Washington home to honest work and maybe even get more done than they do now.

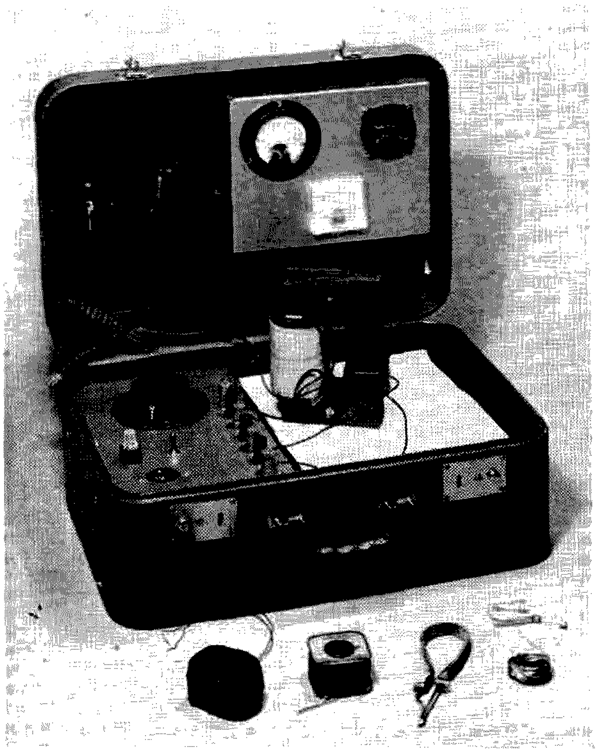
Now, while the D. C. hams are out forming a lynching party, let's mull over this fee business. As a matter of principle I believe that we should not ask non-hams to pay the costs of administration of our hobby. With a quarter of a million hams we can pay our own way. A flat fee of, say, $3 for each application, whether it be for a new license or for renewal, should cover everything quite well.

This could be carried one step further, as with auto licenses, and a special application fee established for specially requested call letters. Many of us would like to get our initials or something like that. The fee would have to be pretty high to keep the percentage of those requesting the special licenses down to reasonable numbers. Perhaps this could be restricted to the Extra Class licensees. What do you think?

Rats, Rats, Rats, Rats

Just as my arm was tiring from patting myself on the back that the June issue came out so well in came a little note from Dave Brown saying that we had mixed the two propagation charts Ugh. Rats! I've been so busy with my head in the clouds trying to plan a super First Anniversary October Issue that I forgot to watch those printers every minute. If you look at the charts at all it is obvious that they are reversed.

Speaking of the future, I've got another little surprise up my sleeve. This is a bonus book which we are planning to send out in November. This will be an Almanac-Yearbook-Buyers' Guide. We will encourage as many manufacturers as possible to run as much information as possible on their products in order to make this a really complete Guide. We're going to try to get the cooperation of as many parts manufacturers as possible too. If you have any suggestions as to material that you think would be appropriate for this book drop me a note. . . . Wayne



I wanted to use one turn per volt for the primary (for ease of calculation), but due to the core being inefficient with this kind of assembly I had to use two turns per volt.

I put a tap at 115 turns to demonstrate auto transformer action using only the primary.

I wound two secondaries, one with 10 turns for 5 volts, and one with 20 turns for 10 volts. Then, to demonstrate the action of the transformer in a soldering gun, I took two pieces of ⅝" wide copper braid and put them in parallel across a soldering gun tip as shown in the photo. When the primary is energized, the tip actually heats quicker than a soldering gun.

I can demonstrate excess current drawn by the primary due to the core being too small, by not having the demonstration core fully meshed, turning up the Powerstat and watching the primary amps increase until the primary fuse blows.

The unit is built in a TV serviceman's tube caddy.

I used a Powerstat to control the primary voltage, which is indicated by a 0-150 volt ac meter.

In the lid of the case I mounted a 7" x 7" x 2" chassis which serves as a panel for the 3

Transformer Action Demonstrator

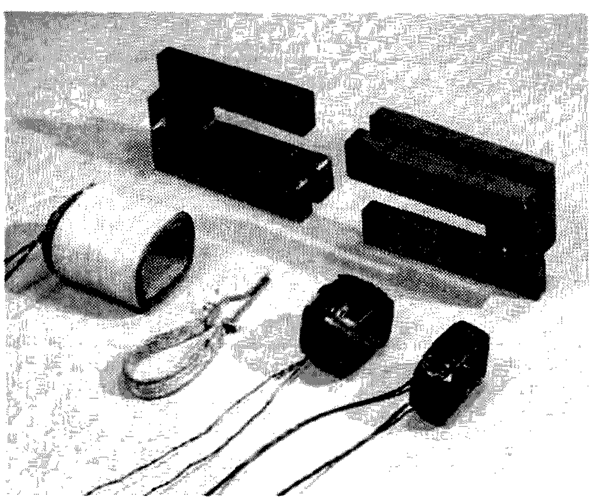
Mike Barlow W8KTJ
2827 Whitehall Road
Muskegon, Michigan

Photos were taken by K8SAF.

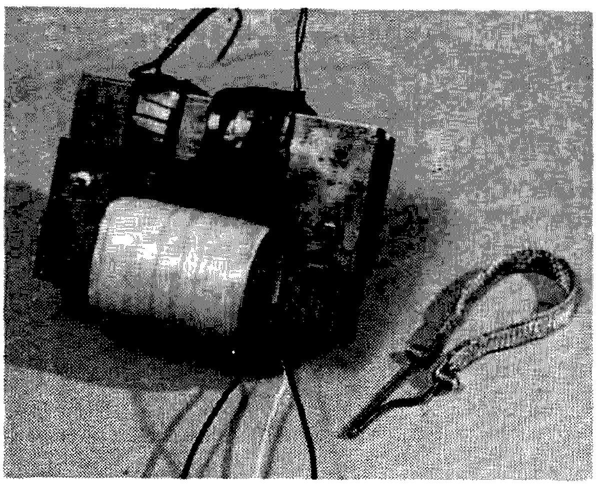
OUR local Radio Club, "The Muskegon Area Amateur Radio Council", has been operating a school for Novice and General class hams for a few years and we have been constantly improving our methods of instruction.

This year I came up with an idea for a physical demonstration of transformer action to give the students an idea of the parts of a transformer in operation.

As illustrated, I used the core taken from an old filament transformer. By rearranging the laminations, I was able to bolt them together in such a way as to allow quick stacking, unstacking and changing windings.



meters. The 150 volt meter is for primary voltage, a 10 amp meter is for primary current and a 0-25 volt meter is connected across two binding posts in the control panel to which the various secondaries are connected during the demonstration.



I also use a single turn of #6 solid wire with a 15 amp fuse link inserted to demonstrate the currents which can circulate in a shorted turn.

After the demonstration and talk are given I ask one of the students to come up and make a winding from a spool of #20 wire which I carry in the case, calculating beforehand what

voltage it will produce.

All of the windings are made of #20 enameled wire, wound on a wood block of a size which will enable them to slip easily on the core.

Just so the photo won't confuse you I will add that there are 3 extra binding posts on the panel for future uses. There is also a receptacle in the panel which is controlled by the Powerstat for the control of future demonstrations which might be plugged into it.

The photos are self explanatory and I hope some other club will be able to make use of this idea as it has been a great help in teaching transformer theory for us. . . . W8KTJ

(Frequency from page 43)

to one ratio is obtained with the beat difference at 5 kc, the final possible error, assuming again the oscillator error does not exceed 0.5%, will be 0.0007%, or 25 cycles. This is close enough for almost all purposes, and well within the specified FCC tolerances.

If higher accuracy is desired, a calibrator using multivibrators for a beat of 5 kc or less can be built. An internal mixer and audio amplifier allows accurate interpolation, and the total accuracy is increased to a minimum of 0.0007%. Usually the error will be much less than this, especially since the audio oscillator can be calibrated to better than 0.1% for this purpose.

Other Ham Publications

In lieu of half of the magazine being filled with specialized departments, we recommend that you subscribe to the bulletin of your special interest. You get a lot more news and get it faster this way . . . and you encourage the fellows who are putting out these bulletins.

WESTERN RADIO AMATEUR. Don Williamson W6JRE, 10517 Haverly Street, El Monte, California. Monthly. Subs are $2 per year, $3.50 for two years, $5 for three years. Operating news of west coast activity, columns on DX, SSB, YL, and some articles. 48 pages

MOBILE NEWS. Published monthly by the Amateur Radio Mobile Society, 79 Murchison Rd., Leyton, E. 10, England. Joining fee and 1 year sub. is $2.50.

HAM-SWAP. Published by Ham-Swap, Inc., 35 East Wacker Drive, Chicago 1, Illinois. Editor is Ed Shuey, K9BDK. Subs are $1 per year by 3rd class mail, $3 for 1st class, $5 airmail, and $7.20 special delivery. Published once a month. Contains classified ads entirely. This is your best bet for an inexpensive way to sell or swap some gear in a hurry. Within two weeks people are answering your ad.

DIRECTORY OF CERTIFICATES AND AWARDS. Clif Evans, K6BX, Box 385, Bonita, Cal. Complete Directory plus three quarterly revisions FREE, $4.00. Add $1 for 1st class mail; $2 for Air Mail. DX stations 1st class, add $1.50 Needless to say this is the most up-to-date data on over 650 certificates and awards available worldwide.

SOUTHERN CALIFORNIA RTTY BULLETIN. Merrill L. Swan W6AEE, 372 West Warren Way, Arcadia, California. $2.75 per year, not including membership in Society. Operating news and some technical articles. This is the oldest TT bulletin going. All TT men should also get this one. Monthly.

73 HAM CLUB BULLETIN. Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Sent free to all editors of ham club bulletins monthly to keep them abreast of what is going on with all the other ham clubs. This is an excellent source of news for putting together your club bulletins. To subscribe to this news bulletin just send a copy of your own club bulletin to Marvin.

DX BULLETIN. Don Chesser W4KVX, RFD 1, Burlington, Kentucky. DX news in depth. Published weekly. 3rd Class mail $5 year; 1st class $6; Airmail $7.50. DX rates on request.

HAM-HOP NEWS. Published quarterly by the International Ham-Hop Club, G. A. Partridge G3CED, 17 Ethel Road, Broadstairs, Kent, England. 75¢ per year for bulletin, $1.50 full membership. Club devoted to arranging visits between hams and ham families all over the world.

Parts Distributors

While trying to drum up some advertising at the Parts Show in Chicago I met quite a few of the parts distributors who are selling 73 over their counters. Many of them explained that they had been beseiged by eager customers to handle 73. Almost all of them mentioned that 73 was outselling the other ham magazines and many claimed that 73 outsold all others combined.

Even so there are hundreds of parts distributors who are not yet handling 73. You can add your 2¢ to the cause by letting me know the name and address of any such delinquent distributor and perhaps needling him a bit so he will be receptive when I send him the details. Look for 73 the next time you are out buying parts.

I'm particularly anxious to keep our circulation increasing as fast as possible so we can pass the 50,000 mark this fall and swing into second place in circulation. . . . Wayne

Advertisers Index

Alden 49
Alltronics-Howard 70
Arrow Electronics 73

Cabral Motors 51
Candee 59
Central Electronics .... Cover II
Clark 65
Clegg 2, 19
Columbia 62
Cushcraft 70

Ebco 27
EICO 7
Electro-physics 66
Elmac 66
Evans Radio 55
E-Z Way Towers 6

Finney 25

Globe Industries 65
Graham 70

Hammarlund 17
Heath 21
Hi-Par 69
House of Antennas (J-Beams) 57

Intenational Crystal 23

JSH 53

KTV 68

Lafayette Radio 5

Maps 68
Mini-Products 55
Mission 67

National Radio .... Cover IV

Petersen .... Cover III
P & H 49
Punches 70

Radio Bookshop 60
Reyco 68
RTTA 67

Shorecrest 65
Space Raider 67
Skylane 53
Subscriptions 16

TAB 71
Tapetone 53
Technical Material Corp. 1
Telrex 65
Texas Crystals 63

Vanguard Electronic Lab. 68
VHF-UHF Associates 69

Western Radio (Nebraska) 66
Western Radio (San Diego) 50
World Radio Labs. 11

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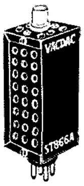

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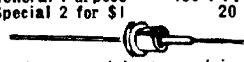

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15AP 750μa, 1¾" Dia, $1.45@, 4 for $5
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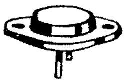

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5V4	.89	12SC7	.89	955	3/$1
5Y3	.60	12SF5	.69	957	3/$1
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6A7	1.00	12SJ7	.75	1614	2.75
6A8	.99	12SK7	.75	1619	5/$1
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6AC7	.72	12SN7	.69	1625	3/$1
6AG5	.65	12SQ7	.69	1626	5/$1
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6B8	1.35	25C5	.81	5663	1.15
6BA6	.59	25L6	.72	5670	.90
6BE6	.59	25T	4.00	5686	1.75
6BG6	1.49	25Z5	.72	5687	1.15
6BH6	.79	25Z6	.75	5691	4.70
6BJ6	.72	26A7	3.69	5725	1.95
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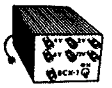

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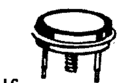
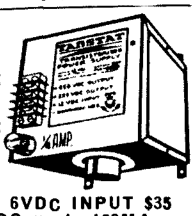
2N173 or 2N443 $5.00 @ 4/$16
($10 or more this item we pay P.P./U.S.A.)



NEW POWER CONVERTER
12VDC to 500VDC up to 200MA
100 Watts; Tap at 250VDC
*Type C1250E $35



TYPE C650E FOR 6VDC INPUT $35
12VDC to 250VDC up to 150MA
Type C1225E $30
C625E for 6VDC Input $30

"TAB" TOROID XFMRS for TRANSISTOR POWER CONVERTERS!
T6-500E/6VDC Inpt. 500VDC & Tap. Max 200Ma $15. T12-500E/12VDC Inpt, 500VDC & Tap, Max 200Ma $15. T6-250E/6VDC inpt. 250VDC, Max 150Ma $14. T12-250E/12VDC Inpt, 250VDC, Max 150Ma $14.

Leece Neville Charger Systems
"SILTAB" Silicon Rectifier Replacement
Non-Aging Hermetically Sealed
FOR 6 or 12VDC @ 100A, Type YJ9 $24

SELENIUM F.W. BRIDGE RECTIFIERS

DC AMP	18VAC 14VDC	36VAC 28VDC	72VAC 54VDC	130VAC 100VDC
½	$1.00	$1.90	$3.85	$5.00
1	1.30	2.00	4.90	8.15
2	2.15	3.00	6.25	11.10
3	2.90	4.00	8.60	13.45
6	4.15	8.00	18.75	31.90
10	6.10	12.15	26.30	41.60
12	7.75	14.90	30.95	43.45
20	12.85	24.60	*Write For*	
24	15.00	29.45	*Rectifier Catalog*	

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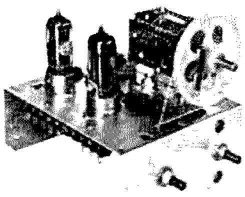
AMERICAN GELOSO V.F.O.'s



Wired, tested, calibrated, ready for use. Mod. 4/104 for driving one 807 or 6146 final in AM or CW under Class "C" conditions.

Mod. 4/102 for driving two 807's or 6146's final. Has 5 bands. Supplied with Mod. 1640 dial ass'y.

Mod. 4/103 for 144-148 mc bands. Combines VFO primary freq. of 18 mc with xtal fundamental freq. of 12 mc. Supplied with Mod. 1647 dial ass'y.

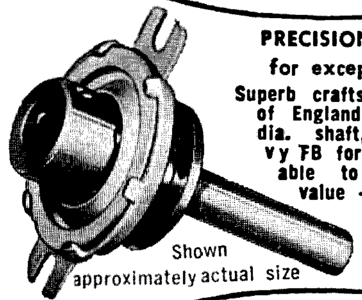
Mod. 4/104, 4/102 or 4/103 less tubes and xtal, each $29.95

AGS—RT—101 CITIZENS BAND TWO WAY RADIO

No license required. Complies with part 15 of FCC rules on low power units. 1.5 mi. average range on land, up to 5 mi. on water. Xtal controlled XMTR, Rec. Sens. 1 μv. Each unit complete with transmitter-receiver, AM radio, leather carrying case, ear-phones, antenna, 6 penlight batteries.

$70.00 ea. 2 for **$139.50**

PRECISION PLANETARY-VERNIER



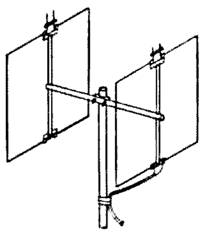
for exceptionally fine tuning

Superb craftsmanship by Jackson Bros. of England. Ball bearing drive, ¼" dia. shaft, 1⅛" long, 6:1 ratio, vy FB for fine tuning. Easily adaptable to any shaft. Comparable value — $5.95.

Amateur Net $1.50 ea.
10 for $13.50

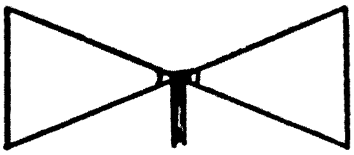
Shown approximately actual size

THE COR-MAC 2 METER CUBICAL QUAD ANTENNA



Complete 2 meter quad antenna kit, machined from the finest alloys of aluminum . . . assemble it yourself with only pliers and a screwdriver. This 2 meter cubical quad was derived from the basic design concept proved so successfully for the 10 and 20 meter beams.

2 meter Kit **$12.50**

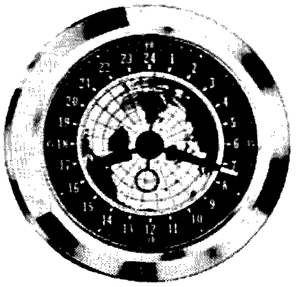


"Wonder Bar" 10 Meter Antenna

As featured in Nov. 1956 QST. Complete with B & W 3013 Miniductor. Only 6 ft. long for 10 meters. Wt. 5 lbs.

Amateur Net $7.85

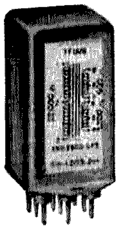
24 HOUR CLOCK



24 hr. chrome plated 8" metal wall clock. Inner dial with south polar projection map of world indicates time around world. Polar projection dial adjustable for various time zones. Shpg. wt. 2 lbs.

110 v. 60 cycle model
$8.47 tax incl.

Versatile Miniature Transformer



Same as used in W2EWL SSB Rig — March 1956 QST. Three sets of CT windings for a combination of impedances: 600 ohms, 5200 ohms, 22000 ohms. (By using center-taps the impedances are quartered.) The ideal transformer for a SSB transmitter. Other uses: interstage, transistor, high impedance choke, line to grid or plate, etc. Size only 2" h. x ¾" w. x ¾" d. New and fully shielded.

3 for $3.49 Amateur Net $1.39 10 for $10.75

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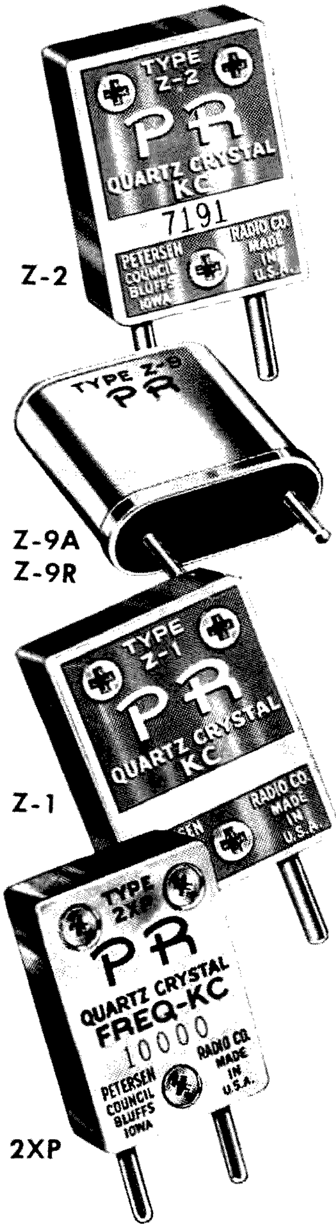

Z-2

Z-9A
Z-9R

Z-1

2XP

AMATEUR TYPES

Fundamental, PR Type Z-2

Frequency Ranges in Kcs.: 3,500 to 4,000 (80M): 7,000 to 7,425 (40M); 8,000 to 8,222 (2M); 8,334 to 9,000 (6M).

Rugged. Low drift, fundamental oscillators. High activity and power output. Stands up under maximum crystal currents. Stable, long-lasting; ±500 cycles.......... **$2.95 Net**

(All Z-2 Crystals calibrated with a load of 32 mmfd.)

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Hermetically sealed; calibrated 24,000 to 24,666 and 25,000 to 27,000 Kc., ±3 Kc.; .050" pins.......... **$3.95 Net**

6 Meters, PR Type Z-9A

Fifth overtone; for operating directly in 6-meter band; hermetically sealed; calibrated 50 to 54 Mc., ±15 Kc.; .050" pins. **$4.95 Net**

CITIZENS BAND CLASS "D"
Type Z-9R, Transmitter

FCC assigned frequencies in megacycles: 26.965, 26.975, 26.985, 27.005, 27.015, 27.025, 27.035, 27.055, 27.065, 27.075, 27.085, 27.105, 27.115, 27.125, 27.135, 27.155, 27.165, 27.175, 27.185, 27.205, 27.215, 27.225, 27.255, calibrated to .005%. (Be sure to specify manufacturer and model number of equipment) **$2.95 Net**

CITIZENS BAND CLASS "D"
Type Z-9R, Receiver

Specify I.F. frequency, also whether receiver oscillator is above or below transmitter frequency. Calibrated to .005%. (Be sure to specify manufacturer and model number of equipment.) .... **$2.95 Net**

Type Z-9R, Radio Control

FCC assigned frequencies in megacycles: 26.995, 27.045, 27.095, 27.145, 27.195, 27.255; calibrated to .005%. (Be sure to specify manufacturer and model number of equipment.) **$2.95 Net**

Type 2XP

Suitable for converters, experimental, etc. Same holder dimensions as Type Z-2.

1600 to 12000 Kc., (Fund.) ±5 Kc.......... **$3.45 Net**

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Commercial Crystals available from 100 Kc. to 70 Mc. Prices on request.

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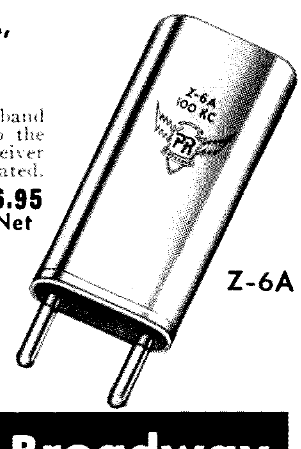
Official assigned frequencies in the range. Calibrated to .005%.
1600 to 10000 Kc.......... **$3.45 Net**

Type Z 1, TV Marker

Channels 2 thru 13.......... **$6.45 Net**
4.5 Mc. Intercarrier, .01%.......... **$2.95 Net**
5.0 Mc. Signal Generator, .01%.......... **$2.95 Net**
10.7 Mc. FM, IF, .01%.......... **$2.95 Net**

Type Z-6A, Frequency Standard

To determine band edge. To keep the VFO and receiver properly calibrated.
100 Kc. **$6.95 Net**



Z-6A

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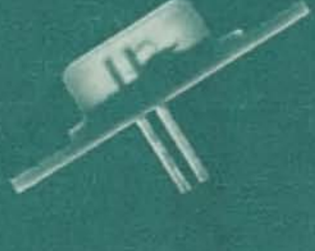
August 1961

37¢

2 for 73¢

73

Amateur Radio



73 Magazine

1379 East 15th Street
Brooklyn 30, N. Y.

August 1961
Vol. I, No. 11

Contents

Frequency Deviation Meter .... John Reinartz K6BJ 6
Another little gadget to build from the brain of one of the top hams of all time.

Noise Limiter .... Thomas Sowers W3BUL 8
For the car. Transistorized, printed circuited, and the board is available.

SSB vs. AM .... Walter Reed KØAXY 12
Year by year count of band occupancy by SSB and AM. (SSB is winning)

Square Antenna .... David Bell W8GUE/6 14
The Bi-Square is easy to build and works out beautifully.

The Drake Receiver .... Frank Merritt Jr. 18
73 rushes you info on the new Drake 2B. Amazing receiver, as you will see.

RTTY Converter .... Bob Barbay W5SFT 24
Transistorized, printed circuit. Board available. Best yet.

Two Meter Nuvistor Cascode Converter .... Larry Levy WA2INM 28
If one Nuvistor is good, why obviously two are better. Obviously.

Versatile Control Techniques .... Roy Pafenberg W4WKM 32
Using those concentric TV controls in your ham rigs and receivers.

Impedance Bridge .... Leon Cholewski K6CRT 33
A whopper construction article. Details on building "professional" equipment.

Propagation, Part III .... Dave Brown K2IGY 42
Antenna height and angle of radiation importance during the coming minimum.

Simple as A — B — C .... Jim Kyle K5JKX/6 44
Clarification (?) of the classes of amplifiers.

The Romance of Dixie Dan .... Ken Johnson W6NKE 46
One of the better ham poems from our Renaissance man.

Propagation Charts for August .... Dave Brown K2IGY 48
What time to where, when, on what bands . . . even inside the US . . . maybe.

Four Kinds of Ham .... Jim Kyle K5JKX/6 50
A general discussion of stuff you've read before. The Golden Rule again.

Mobile Power Converters .... Austen Farrell W2BXE 54
Transistor supply using filament transformers. Very clever . . . and cheap.

73 Tests the Finney 6 & 2 Meter Beam .... Don Smith W3UZN 56
Interesting invention. You'll want one if you read. Beware.

New Look At Old Ideas About Antennas .... James Kyle K5JKX/6 62
The old timers really knew what they were doing . . . we can lear a lot.

Hiss, Sputter or Crash .... J. Kyle K5JKX/6 66
Different types of noise and what to do about each of them.

Portable KW Transistor XMTR .... Wretched Coward K2PMM 72
Newly released (early April) transistor makes shoe box KW simple.

Misc.:

de W2NSD 2
Subscription Data 4
Club Subscriptions 4
Old Old Timers Club Note 11
Transistor Symbols 17
Universal Rectifier Socket 31
Repairing Schematic Drawings 45
Letters 47, 53
Life Subscriber #1 53
Antenna Relays 64
New Products 64

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COVER: Power Transistor innards as seen by James Tonne W5SUC.

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. . . de W2NSD

(never say die)

Back at first I was running hamfest and convention announcements. Several postcards have mentioned that they are not particularly anxious to have space taken up with local announcements in a national magazine. I'm in agreement with this notion since we're trying to make sure that everything in the magazine will be of the widest interest. For that matter, though you may be looking particularly for VHF articles, you will find that just about everything we publish will be good reading. Some of the best articles may be hidden with unlikely titles too. Heh! If you disagree about our leaving out announcements all you have to do is pound the table a little and we'll start an (ugh) Announcement Column.

Cover

The July cover brought interesting reactions. Several readers wrote in to mention that, though their cover was OK, they found the rest of the magazine to be printed upside down. Subway and bus readers startled their fellow travelers. There were a few fellows who called up to find out if we knew the cover was upside down. These chaps should know all the trouble we went to, to make sure that it got printed that way. This included verbal and written instructions to the entire work force of our printer's New York office where the magazine is set in type as well as the entire force in Norwalk, Connecticut where it is printed. We really expected that someone wouldn't get the word somewhere along the line and would "fix" the mistake.

Our printers are getting used to us now. They no longer shudder at our printing a 73 page magazine, no doubt the only magazine in history to do so. They are getting used to our surplus ads with the five point mice type, though they fight every one we bring in and charge until our heads spin for them.

We have made great strides on the delivery of magazines to our office. We almost fainted the first month when the truck drove up with 10,000 copies on a huge skid. The office was on the second floor and Virginia and I had to hand carry 2500 pounds of magazines upstairs. The next month we got them to mail a lot of them directly from the plant and deliver the rest in cartons. Virginia has gotten very good at hefting those 65 pound cartons up the stairs now . . . somehow I always seem to be away when the truck comes. They increased the cartons to 85 pounds last month. Virginia almost broke her back. I complained. The following note came from the printer. "Your lastest epistle decrying the weight of our cartons has caused me deep chagrin, pain and a wart on my left index finger. It has never been the policy of Ye Olde O'Briene Presse to cast a Dresden-like beautiful orchidious creature like Virginia in the role of a Russian weight lifter. The dastardly culprit who sponsored this hernia-inviting operation right now is on his way to the salt mines, minus both thumbs. Rest assured most kind sir that our cartons in the future will be of a gossamer quality and of a weight that can be handled by the midget masquerading as a little girl in the Castro Convertible Ads. Regards, Charles Joseph Hauser III* (*The first two were executed for mopery.)"

Answered Plea

The small call for help last month was answered. Volunteers arrived from all over. One of the long distance helpers was Hall Bond K5ZSB of Dallas, a pilot for Braniff Airways, who dropped in and lent a hand for a few hours of stencil sorting. All this extra help has enabled us to get out a lot more mail recently and we've sent out the first mailing to advertisers announcing the First Annual Almanac, Yearbook and Buyers Guide which we plan to publish this fall.

One thing that has bugged me for years is the problem of finding out about a product when I want to know about it. Someone will mention over the air that he has one of the new Super-Bandbangers and that he thinks it it great. I immediately plunge into the ham magazines looking for more info. Well, it seems I've heard about it a bit late and they are now advertising the newer Rx-7388. After much searching through back issues I finally find some ads for the Bandbanger, but they sure don't tell very much. Being persistent, I

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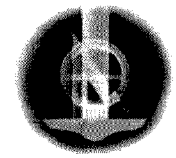

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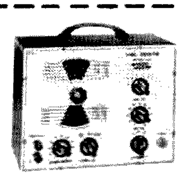
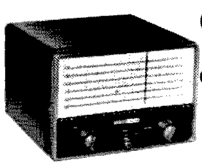


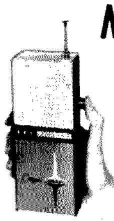
90-WATT CW TRANSMITTER* #720
Kit $79.95 Wired $119.95
*U.S. Pat. #D-184,776
"Top quality"—ELECTRONIC KITS GUIDE
Ideal for veteran or novice. "Clean" 90W CW, 65W AM-phone with EXT plate modulation. 80 through 10 meters.

60-WATT CW TRANSMITTER #723
Kit $49.95 Wired $79.95
"Compact; well-planned layout. Clean-sounding, absolutely hum-free carrier; stable." — ELECTRONICS WORLD.
Perfect for novice or advanced ham needing low-power standby rig. "Clean" 60W CW, 50W AM-phone with EXT plate modulation. 80 through 10 meters.

New! **VARIABLE FREQUENCY OSCILLATOR (SELF-POWERED) #722**
Approaches crystal stability. 80 through 10 meters.
Kit $44.95
Wired $59.95



New! **CITIZENS BAND WALKIE-TALKIE #740**
Complete with rechargeable battery and charger. 9 transistors, 1 diode. Full superhet. U.S. made.
Kit $54.95
Wired $79.95



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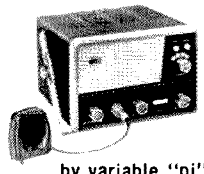
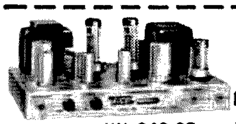
Superhet; prealigned xmitter osc; match different antennas by variable "pi" network. Single & multi-channel models.
From Kit $59.95 Wired $89.95



HIGH-LEVEL UNIVERSAL MODULATOR-DRIVER #730
Kit $49.95 Wired $79.95
Delivers 50W undistorted audio for phone operation. Can plate-modulate transmitters having RF inputs up to 100W. Unique over-modulation indicator. Cover E-5 $4.50.



GRID DIP METER #710
Kit $29.95 Wired $49.95
Includes complete set of coils for full band coverage. Continuous coverage 400 kc to 250 mc. 500 ua meter.

PEAK-TO-PEAK VTVM #232 & exclusive *UNI-PROBE®
Kit $29.95
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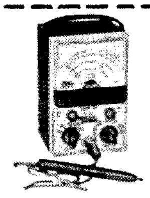
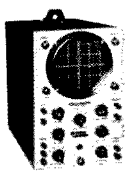
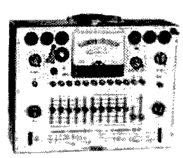


DC-5MC LAB & TV 5" OSCILLOSCOPE #460
Kit $79.95
Wired $129.50
5" PUSH-PULL OSCILLOSCOPE #425
Kit $44.95 Wired $79.95



DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666
Kit $69.95 Wired $109.95
TUBE TESTER #625
Kit $34.95 Wired $49.95



RF SIGNAL GENERATOR #324 (150kc-435mc)
Kit $26.95
Wired $39.95
TV-FM SWEEP GENERATOR & MARKER #368
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ENGINEERS: Excellent career opportunities in creative electronics design. Write to the Chief Engineer.

hunt around until I find some letter paper, an envelope, and a stamp. This usually is quite a hard combination to round up all at one time. Then I start drafting the letter asking for a spec sheet. I am rewarded two weeks later when the info comes in the mail . . . only I wonder why they sent me all this, did I write for it? Maybe I did a couple weeks or so ago.

I've tried to solve this difficulty by laying in a good selection of the larger distributor catalogs. Unfortunately only a few distributors seem to carry the Bandbanger line and all they have is a short paragraph on it, telling less than the magazine ads. Even Radio Master doesn't do much for the ham contingent. The answer, I think, is a yearly Buyers Guide for ham products. We're going to try to get just such a thing started. I hope it doesn't turn out that I am the only chap who has suffered through these problems. A letter is now out to all of the ham manufacturers to see their reaction . . . will it be enthusiasm or apathy? I'll let you know.

Yearbook Articles

This is going to be a real low budget production in order to get as many advertisers to come in as possible. The ad rates will be ridiculously low. This means that there won't be much budget for articles for the book. I've a solution that should make almost everyone happy . . . and that's the best type of solution, eh? Material should be received by the end of September at the latest, which gives us about two months.

The Yearbook, it strikes me, is an excellent place to run quite a few tests of commercial equipment. This should be a snap for many of you who have the equipment on hand and also have a reasonable test setup to check it out. We'd like to have articles on any of the newer pieces of equipment that we have not

(Turn to page 41)

Club Subscriptions

As announced a few months ago, clubs may send in group subscriptions at the rate of $2.50 per one year subscription in groups of five or more subscriptions. These subs must start with the next published issue and be for just one year. Orders for back issues should be sent in separately. By simplifying the procedure we can offer this reduced rate.

The regular subscription rate is $3 per year; $5 for two years; $4 per year for DX operators outside North America. All back issues are 50¢ each. Send your name, call and address to 73 magazine, 1379 E. 15th St., Brooklyn 30, New York. Include money.

Capt. John L. Reinartz USNR 'Ret.' K6BJ
220 Mar Vista Drive
Aptos, California

Let's Make it a Frequency–Deviation Meter

A frequency-deviation meter allows one to read the deviation plus or minus that a received signal is off frequency. Depending on the meter range desired and used, a deviation of ten or less cycles can be read either high or low. Such a device is especially useful when used on MARS nets or when frequency checks are desired of any incoming signal and the answer must be in cycles low or high of a desired frequency. Those grinding their own crystals or desiring to compare crystals will find this device especially useful.

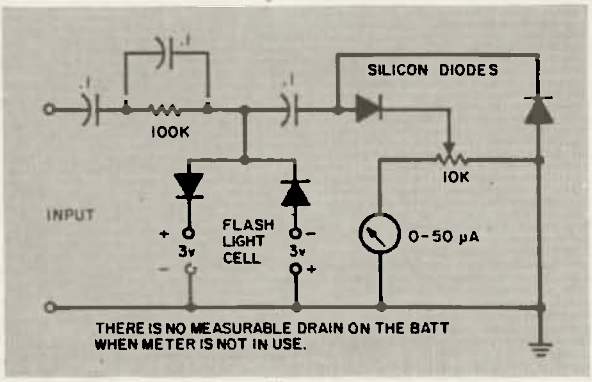


Fig. 1

Two fundamental circuits were investigated, one using diodes only and the other using transistors only. These are shown in Fig. 1 and 2 respectively. A 0-50 microampere meter should be used for the diode type and a 0-1 milliampere meter will serve nicely for the transistor type, although a 0-50 or 0-100 microampere meter will also serve nicely in the transistor type frequency-deviation meter system. Silicon diodes were used for the diode type and 2N123 for the transistor type. An input voltage of 25 is needed for the diode type and 7 volts or less for the transistor type depending on the meter sensitivity, being 2 volts when a 50 microampere meter is used.

Whatever scale reading is desired, be it 250 cycles low or high or 500 cycles low or high, the meter cover is removed and new figures are added below the meter scale with a zero in the center of the scale and maximum readings at each end of the scale as appropriate. Pencil markings will do. The 250 cycle can be read to 10 cycles per division and the 500 cycle scale can be read to 20 cycles per scale division. Each can be read to half these values or 5 and 10 cycles respectively.

In use, you set your frequency meter, LM or 221 either 250 cycles or 500 cycles lower than the frequency to be checked. If the frequency to be checked is right on, the frequency-deviation meter will read zero at the center of the scale on the meter; if the frequency is low, the meter will read low and if higher, the meter will read higher. The answer in cycles will be the value indicated by your new markings. In use the frequency-deviation meter is connected across the high impedance output of your receiver in the case of the diode type and across the low impedance output in the case of the transistor type.

In those cases where a definite frequency will be under observation, it will be found advantageous to grind or obtain a crystal that is adjustable to 250 cycles low or 500 cycles low, as appropriate, and to use it in the transistorized oscillator shown in Fig. 3. Any crystal holder that has an adjustable air gap will do. Some of the TCS surplus crystal holders have a three point adjustable top plate and are about the best obtainable. Since your best and probably only method of adjusting the crystal is by the use of your LM or BC221, be sure that your frequency standard is accurate. It is best to use the low frequency position and with the 1 mc crystal switch on, tune the meter to that portion of the desired frequency less the mc part. For instance, to set the LM for a reading of 2,732,000 cycles, set the LM on the low frequency for 732,000 cycles or 732 kc. The 1 mc crystal will furnish the

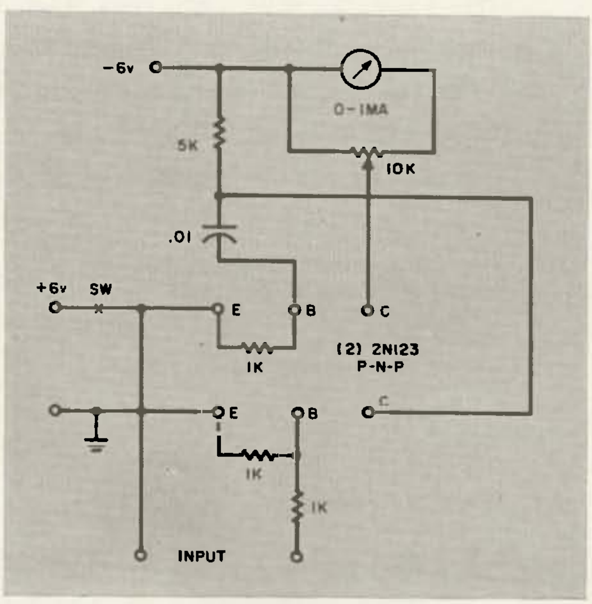


Fig. 2

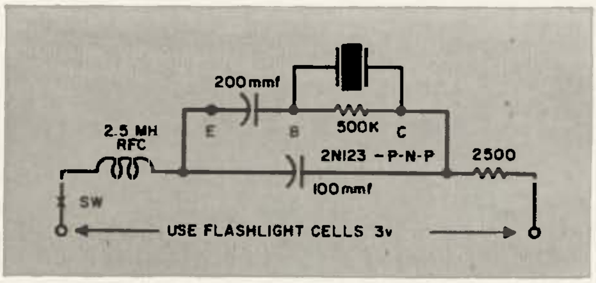


Fig. 3

mc part of the reading. In my case I set the LM to 731.5 kc and adjust the crystal to that frequency in the adjustable TCS holder. The transistorized oscillator holds the frequency to such a close tolerance it has not been necessary to make adjustments in weeks. A hand held push switch connected into the positive battery lead allows the oscillator to be turned on as needed to check the frequency of a MARS station on 2732 kc to an accuracy of plus or minus 10 cycles of that frequency. The frequency-deviation meter is of course checked against the 440 or 600 cycle tone of WWV, no other check is necessary since the scale is linear. . . . K6BJ

Circuit board for this meter available soon from Irving Electronics.

Letters

Dear Wayne:

First let me congratulate you upon your fine layouts, content and presentation in "73." It's about time the ham radio literature again emphasized some home constructed equipment, rather than the ever increasing emphasis on commercial gear.

I constructed the transistorized grid dip oscillator which was described in the March 1961 issue. I found, however, that there were two errors, which perhaps you would be interested in calling to the attention of other readers:

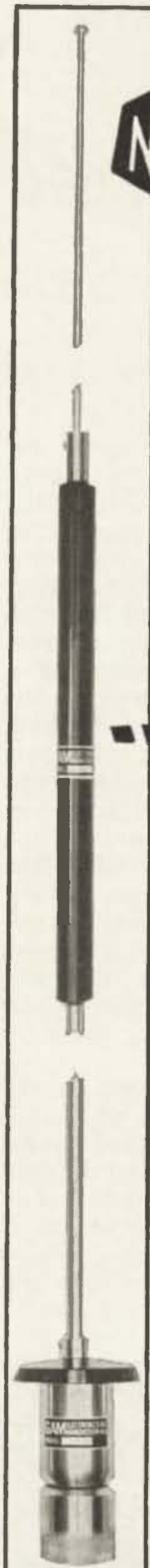
1. Switch S1A is in the wrong line. It should be connected in the 9 volt battery line which, under the present circuitry, is constantly under drain conditions.
2. Besides the minor detail mentioned in item 1, I could not get the oscillator to oscillate until I finally discovered that a .0047 disc ceramic condensor connected between the base of the 2N247 to ground did the job beautifully.

Being an "old timer" in the radio field, I thought perhaps you might be able to steer me towards some article on conversion data to bring the Abbott TR4-B 2-meter transceiver up to date, so as not to invoke the wrath of the FCC. If you have any knowledge of this I would certainly appreciate your passing it along. I was intending to do some revamping of the TR-4, and thought it would be wise to investigate any work done on it in the past.

Again, many thanks. Keep up the swell job.

Sigmund G. Bookbinder K2PFG
Boy Scouts of America
25 W. 43rd Street, N. Y. 36

Thanks, Sig, for your compliments. The note on the GDO may help a bit too, though we pointed out last month that the battery switch was hooked in wrong. Perhaps a difference in transistors made the .0047 necessary as many readers have written in saying that the circuit works fine for them. It is a good hint for anyone who might run into problems. I haven't any info on the TR-4, but maybe you're letter will bear fruit and bring you what you need to know.



Printed Circuit Noise Limiter Using Semiconductors

Thomas C. Sowers W3BUL
47 Bethlehem Pike
Colmar, Pennsylvania

AFTER being mobile for several months we had the misfortune of having to change cars as the 1952 Pontiac, which we used for mobile, was beginning to fall apart. The mobile gear was moved from the Pontiac to a 1953 Studebaker. This gear included a TNS limiter which was installed in the Pontiac radio to reduce ignition noise. It was a great disappointment after all the labor involved in transferring the equipment from one car to the other to find we were troubled with ignition noise from other cars. The TNS limited performed very well in the Pontiac but performance was just plain poor in the Studebaker. The diode load resistor in the auto radio was reduced and finally eliminated entirely. The diode in the second detector was grounded and a crystal diode installed in its place. Shielding was tried here and there and just about everything in the handbook and in mind was tried without success. We finally gave up and decided on building a full-wave series noise limiter.

After some serious thinking we set on the idea that the noise limiter would use semiconductors and would have a printed circuit board. The 10 meter converter used in conjunction with the auto radio uses semiconductors and also a printed board. The target of the writer is a compact transistorized transmitter or at least a hybrid using only one tube on the final.

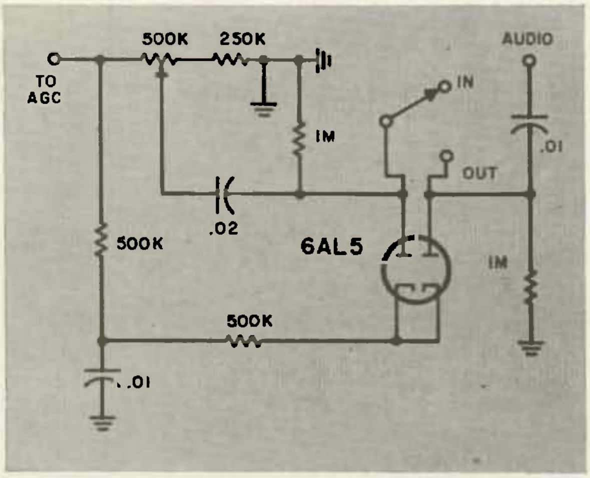


Fig. 1

In starting off, a conventional full-wave series noise limiter circuit Fig. 1 was considered. This type of limiter usually uses a 6AL5 and 12AL5 dual diode. The only changes made on this limiter was replacing the 6AL5 or 12AL5 tube with two suitable crystal diodes Fig. 2.

Construction

The early experiments using various types of diodes were made on a circuit which was constructed on a punched phenolic board.

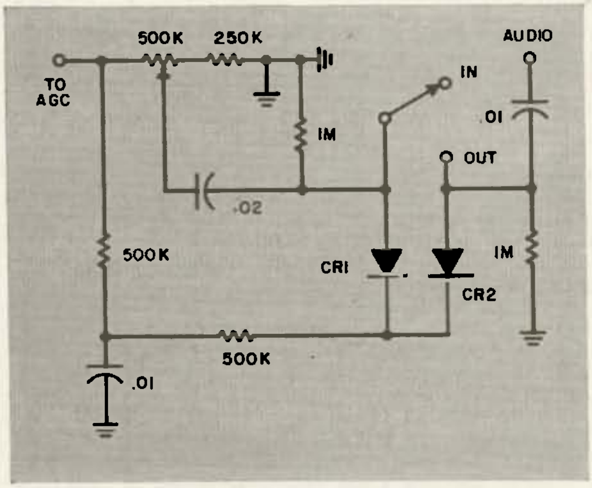


Fig. 2

Three general purpose crystal diodes, the 1N60, 1N91 and 1N93 were tried with little success. It was found that any signal into the receiver was large enough in amplitude to cause the diode to conduct and chop off the audio and what signal did get through was very much muffled. From the above results we knew we would need diodes with a high inverse resistance and low forward resistance. These characteristics are found mainly in the silicon diode and not types produced from germanium. Another test was made using two *Philco* SAT transistors having only one good diode in each. The ICO or IEO on these units measured less than .1 μa at 20 volts so the inverse resistance on the diodes is well up in the megohms. The base lead of the transistor is used as the cathode and emitter or collector lead as the anode. This proved to be the right diode as noise from passing autos was brought

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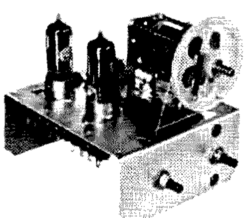

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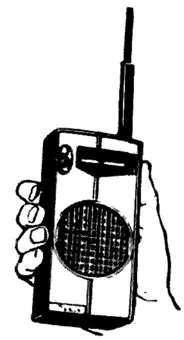

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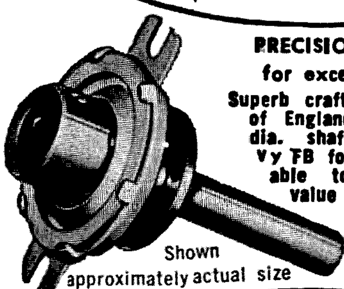

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Superb craftsmanship by Jackson Bros. of England. Ball bearing drive, ¼" dia. shaft, 1⅛" long, 6:1 ratio, Vy FB for fine tuning. Easily adaptable to any shaft. Comparable value — $5.99.

Amateur Nat $1.50 ea.
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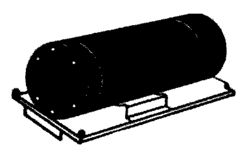

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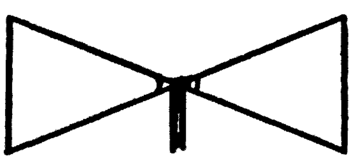

As featured in Nov. 1959 QST. Complete with B & W 3013 Miniductor. Only 9 ft. long for 10 meters. Wt. 5 lbs.

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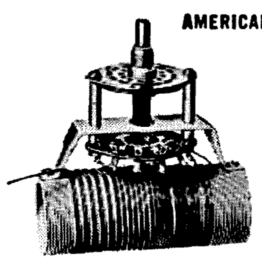

Units have 6 posit. tap switch mounted on ceramic coil form. Mod. 4/111 designed for use with two 807's or 6146's (in parallel). Freq. Range 3.5 to 29.7 mc.

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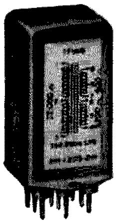

Same as used in W2EWL SSB Rig — March 1956 QST. Three sets af CT windings far a combination of impedances: 600 ohms, 5200 ohms, 22000 ohms. (By using center-taps the impedances are quartered.) The ideal transformer for a SSB transmitter. Other uses: interstage, transistor, high impedance choke, line to grid er plate, etc. Size only 2" h. x ¾" w. x ¾" d. New and fully shielded.

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3 for $3.49 10 for $10.75

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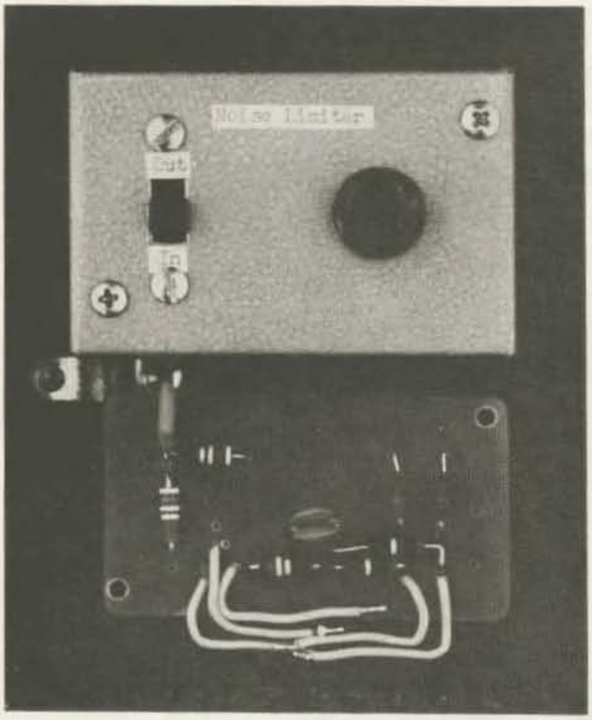


down well below signal level and even performed as well as the TNS limiter in the Pontiac except for the squelch action. A printed circuit board was then constructed and components were transferred from the phenolic board.

Printed Circuit

Material List for Circuit Board

1. Copper clad laminate board 1⅝ x 3 inches cut from 3 x 4½ piece, No. MS-512.
2. Tape resist circles 3/16 inch diameter, No. MS-737.
3. Tape resist 1/16 x 320 inches, No. MS-735.
4. Etchant 6 oz., No. MS-729.

All materials for printed circuit board ordered through Lafayette Radio, Jamaica 33, New York.

The construction of printed circuit boards was described in length in November issue of 73, "Transistor Printed Circuit 10 Meter Converter." The procedures for constructing the circuit board for the noise limiter will be described very briefly in ths article. Lay Fig. 3 drawing over copper clad board with a piece of carbon tracing paper between and trace out all circles and connecting bars. After tracing, apply resist circles and 3/16 inch resist tape to circuit board. Etch board for 20 to 30 minutes in etchant solution to remove all excess copper. Remove resist tape

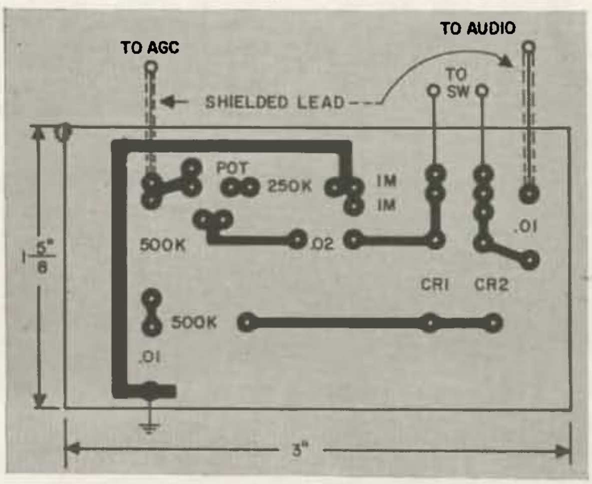
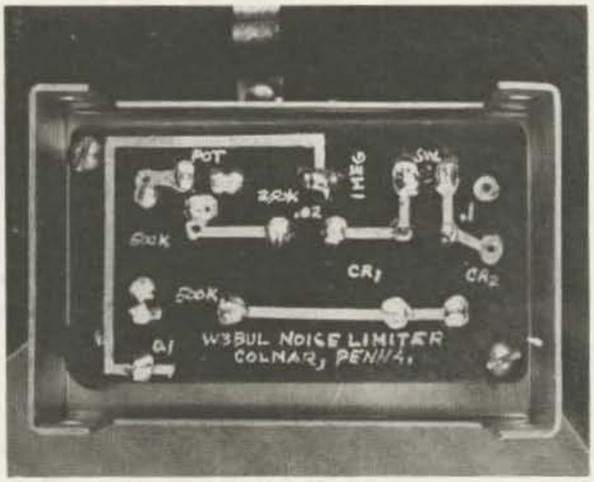


Fig. 3



and drill 1/16 inch holes for mounting component parts. Mount components as shown in Fig. 4 and solder in place using a good rosin core solder.

The author mounted the circuit board, .5 megohms potentiometer and a small slide switch in a small *Bud* Minibox 1⅝ x 2 x 3¼ inches in dimensions. The small box was then mounted under the dash of the auto near the receiver. Shielded leads are brought out from the auto radio to the noise limiter to reduce

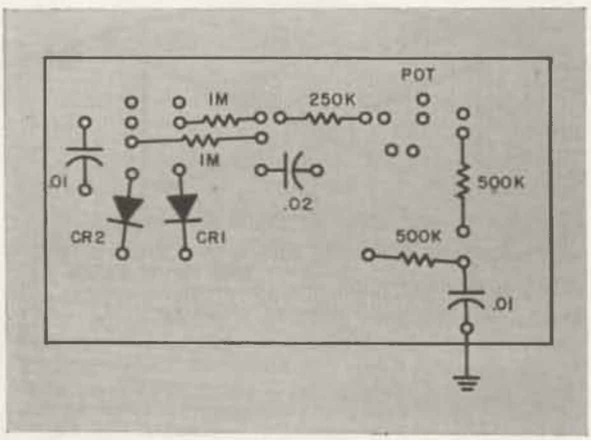


Fig. 4

hum and pick up. The circuit board is small enough to mount in the receiver of most any auto radio for those wishing to do so. The .5 megohms potentiometer may be mounted in any convenient location on the receiver and the switch may be left out. With the limiter switch on the *IN* position some gain is lost on the receiver, but most auto radios have gain to spare. The author uses the switch

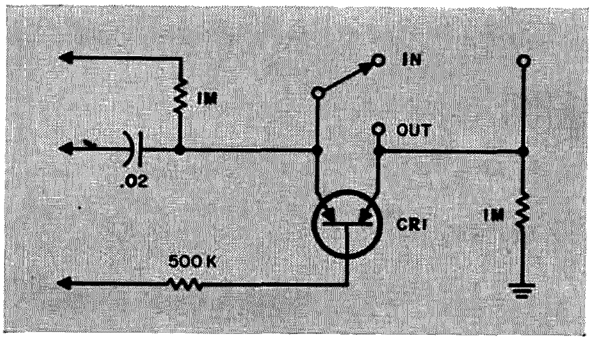


Fig. 5

mainly to prove to himself and others in demonstration how well the limiter really works.

After the circuit board is made and the noise limiter completed the maker may wish to experiment with various types of diodes. Its simply a matter of tacking diodes in place with the soldering iron. We recommend using silicon diodes with high back resistance and low forward resistance. We have used the 1N536, 1N537, 1N538 and 1N625, with the 1N625 diode giving best results. It is known that at least 50 diodes are commercially available suitable for noise limiters. The author is presently using a dual silicon diode Fig. 5 manufactured by the *Philco Corporation*. The unit uses a common cathode and two anodes and is mounted in the small TO-18 package and should be on the market shortly. It is expected to be seen in some of the communication receivers in the near future.

The described noise limiter using various diodes has been in the author's car for over six months and is still doing a satisfactory job. Several amateur friends have constructed the noise limiter and are using it with equal results. A noise limiter used in conjunction with a 10 meter rig makes the difference of making contacts in motion or just plain talking to yourself. . . . W3BUL

The circuit board for this noise limiter is available from Irving Electronics, P.O. Box 9222, San Antonio, Texas, for $1.00.

O. O. T. C.

The OLD OLD TIMERS CLUB is making a canvass to determine the number of Amateurs holding a license and call today who were listed in the first Government call book, in 1913.

If you are one of those, please write the OLD OLD TIMERS CLUB, Earl C. Williams, Secretary, 507 Wayside Road, Neptune, N. J. giving first call, present call, and any other details believed pertinent.

Walter W. Reed KϕAXY
St. Joseph's Hill Infirmary
Eureka, Missouri

Brother Brenden checks one ear to see whet damage extended listening to 75 meters may have done while Nurse Lea tries to clean out the 40 meter hokum from the other.

SSB vs. AM

SINCE the advent of SSB, its popularity has been steadily gaining. At its present rate of growth, SSB will account for almost all the phone signals heard on the ham bands in a few years.

While contemplating the purchase of SSB gear, my Scot soul asked the question: "Is there sufficient occupancy on SSB and enough favorable facts about SSB to justify the purchase of SSB gear?" A careful search through the magazines and other literature revealed that there was insufficient proof as to the amount of SSB activity.

Consequently, in the Octobers of 1957, 1958, 1959, and 1960, I endeavored to count all the "Q5" AM and SSB signals on the 10, 15, 20, 40, and 80 meter phone bands. Being a shut-in invalid, plenty of free time was available for counting. Even the night nursing brother cooperated by awakening me at the hours requested. For a number of statistical reasons, October was selected as being the best month.

The results are shown in the following table.

Almost 4000 signal counts were made, each one documented by call letters. Each hour of the day was checked on at least 7 days in October. Some hours had as much as 20 days of sampling.

It certainly looks as if SSB is beginning to live up to its often bragged about reputation as the most efficient mode of phone transmission. The percentage charts clearly show how SSB is gaining on AM. It is now apparent that SSB occupies a major segment of the phone bands. The remaining question is now: "How long will it be before AM becomes obsolete?"

. . . KØAXY

PERCENTAGES OF SIGNALS THAT ARE SSB ON THE HAM BANDS

HOURS—	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24:00 C.S.T.
80 Meters																								
%-1957—	19	24	22	14	13	17	15	15	15	12	08	*	*	*	"	12	18	20	22	30	37	33	33	15—%
%-1958—	29	18	14	17	29	21	13	11	23	*	*	*	"	"	"	"	"	17	28	32	32	34	36	30—%
%-1959—	25	26	16	18	19	15	21	17	09	*	*	*	"	"	33	24	35	37	40	44	42	40	30	32—%
%-1960—	51	30	29	26	32	27	31	38	33	*	*	*	"	"	37	36	42	41	52	51	49	54	56	45—%
40 Meters																								
%-1957—	13	10	00	06	03	10	13	13	11	15	13	09	15	40	15	13	20	27	27	34	33	36	33	28—%
%-1958—	10	07	08	13	09	09	10	15	21	17	16	14	16	18	14	20	14	25	29	31	42	40	33	31—%
%-1959—	23	30	25	13	22	21	24	20	24	17	20	20	19	21	18	22	35	33	42	34	39	35	37	35—%
%-1960—	34	19	28	27	27	21	26	29	25	27	41	33	31	34	21	34	42	43	44	39	38	47	43	39—%
20 Meters																								
%-1957—	30	40	25	24	30	40	33	27	31	30	32	27	39	35	30	30	33	37	39	43	29	35	35	35—%
%-1958—	34	32	†	†	34	37	36	39	36	38	38	40	35	32	28	37	31	35	34	39	40	41	41	41—%
%-1959—	**	**	**	**	34	42	43	38	38	50	47	45	47	43	47	39	41	44	44	44	43	53	†	†—%
%-1960—	**	**	**	"	"	"	48	53	45	40	50	47	46	50	50	48	50	51	54	53	61	31	36	30—%
15 Meters																								
%-1957—	*	*	*	"	"	"	"	03	26	18	17	11	17	15	17	00	19	21	20	15	17	17	17	23—%
%-1958—	*	*	*	"	"	"	27	21	26	20	16	15	19	18	29	18	24	22	16	22	27	33	†	†—%
%-1959—	*	*	*	"	"	20	21	25	33	27	27	22	23	21	23	30	27	32	25	32	34	**	**	**—%
%-1960—	*	*	*	"	"	"	"	25	13	33	41	40	32	41	36	37	33	36	37	26	*	*	*	*—%

10 Meters

Insufficient SSB signals—less than two percent.

† Out
* Band Out
** Poor Band

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A Square Antenna

THE story of the square antenna should be preceded by one or two Twentieth Century observations. First is: hams are vacating the cities for the promised land of suburbia. Unfortunately, there is no more land in suburbia than downtown. This writer recently moved from a downtown Baltimore row house (with a spacious yard) to a Los Angeles suburb (with a putting green). The second observation deals with antennas and, in a sense, with lot size. I can't remember the last time I talked to anyone who wasn't using: a beam, a quad, a vertical, a dipole, or a "long wire." How about you? Have you talked to anyone using an antenna-exotica lately?

The square antenna about to be described not only works but is an amazing conversation piece. The user of this antenna is automatically "one cut above" the dipole or vertical user. In addition to these benefits, you don't have to be a whiz at antenna theory to put it up, nor do you need fancy test equipment, a big yard, a 70 foot tower, or 200 bucks. All you need is about $15.00 and a day. You only need $5.00 and half a day if you already have a tower or mast.

The bi-square antenna is four half-waves in phase, which makes it three half-waves and about 4 db better than a dipole. The bi-square to be described is for 15 meters, but I have used them on 20 and 40 in years past with the same success.

The advantages of this antenna are many. It's cheap (prime consideration). You need only one pole, 35 feet or over, to hang it on. It is bi-directional. You can hang two of them on one pole and cover 360 degrees. It's easy to tune. It has 4 db gain, which puts it in the well tuned two-element beam class. It is also good competition for the "pre-tuned" or untuned three-element beam. In short, it's a great little antenna. And yet it's as rare as a democrat in Maine.

The bi-square filled my needs perfectly. It's a foolproof wire with adequate gain which can be erected in a small space (see Fig. 2). My first three contacts were Hawaii twice and a maritime mobile off the East coast of South America. S-9 or better all the way around, with a mere 150 watts of sideband.

Figure one almost tells the whole story. Each side of the bi-square is a half wavelength at the high end of 15 meters. It is open at the top, terminated at a dipole insulator. The ends are held aloft by strain insulators to ropes to fenceposts to trees, lightpoles, or other handy anchors. The base of the bi-square, which in my case is about 4 feet from the ground, is terminated in a quarter wave, shorted stub, 12 feet long. The whole fandangle is fed with twinlead. The only stopper is the matching stub and that's no hill for a climber.

Since the base of a bi-square is a voltage point, it has to be matched with a quarter wave, *shorted* stub. The stub is 12 feet long, before shorting, and can be an extension of the legs of the bi-square or "ladder-line" or any other size wire that's handy. I used number 18 enamelled wire spaced at 3 inches. Stub spacing should be 4 to 5 inches for larger wire.

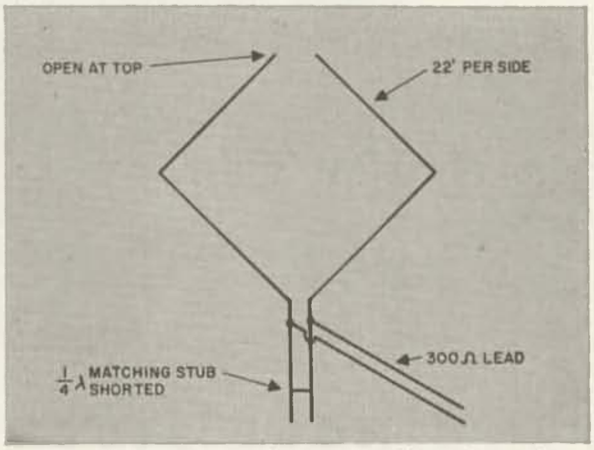


Fig. 1. Bi-square antenna for 15 meters. A horizontally polarized, broadside, bi-directional array with a gain of about 4 db. It is constructed with ordinary antenna wire and fed with twinlead. It requires only one 35 foot (or taller) pole for support.

As can be seen in Fig. 3, stub wires are held a constant distance apart by TV standoffs, but the purist would want spacing insulators. My stub runs vertically up the mast from the base of the bi-square. This is probably not the best direction to take a stub, but I had little choice. At least it keeps everything symmetrical, which is a consideration.

Fig. 2. The wide open spaces of Suburbia. The vertical board is actually an "A-frame," end view. The broadside of the bi-square is parallel to that lovely fence, dividing my tenth-acre estate from my neighbors.

The first step is to get the antenna in the air and get the stub attached. My mast has a rope-pulley arrangement a la flagpole. The next thing is to locate the point at which the stub is to be shorted. An easy way to do this is to "shock-excite" the bi-square. Fire up a nearby antenna with 15 meter energy and check for a high current spot on the bi-square stub. This can be done by using your simple light bulb rf detector. Shorting the stub with this gadget, find the point of maximum bulb brilliance, and that's where you make a permanent short. Use a low-current bulb (dial lamp) and be sure to scrape enamel from the portion of the stub you're testing. The short will probably come within thirty inches of the end. If you have a grid dip meter you may find it simpler to use that handy device in tuning the stub. Place a temporary short near the end of the stub, and with your dipper, check the frequency. Move the shorting wire until you're on the desired frequency. Instructions covering this procedure are detailed in your grid dip meter manual.

After the stub is properly shorted, the next step is to connect the twinlead feedline. I soldered alligator clips to my twinlead for this little chore. All you have to do is move the feedline up and down the shorted stub until you have a desirable standing wave ratio. After only about 10 minutes of fooling I got

(Turn to page 16)

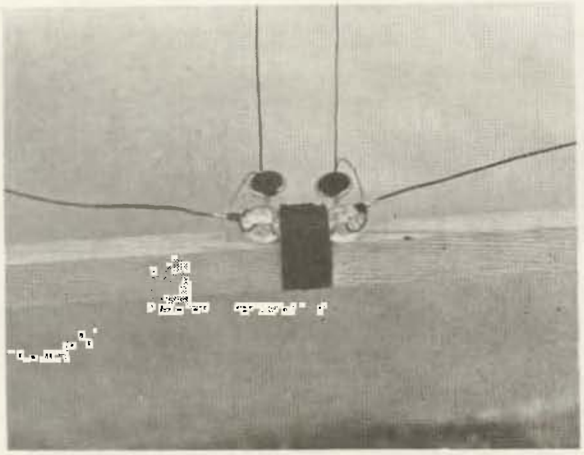


Fig. 3. The base of the bi-square. The timber is the crossmember of the "A-frame." TV standoffs are used to space the stub wires about 3 inches apart. (The small wires are the stub, the heavy wires are the beginnings of the antenna.) That's friction tape securing the base insulator.

my SWR down so low it's not worth mentioning.

Once, before the popularity of the SWR bridge, I connected a bi-square feedline merely by finding the point on the stub where the transmitter loaded best. So, if you don't own an SWR bridge and can't borrow one, just hook the feedline for maximum output. (I am assuming that if you don't have an SWR bridge you don't have field strength measuring equipment. If you do, the use of said equipment would be preferable, of course. Field strength checks are worthwhile under any circumstances).

The only other problem is that of matching your transmitter to the 300 ohm feedline. If you have balun coils you're all set. If you don't, you might be interested in the balun I constructed. This particular balun idea was first given me by Jack, W8LIO. It is used occasionally to match coax to beams, but rarely as a balun, matching coax to twinlead. It's both simple and cheap. Fig. 5 shows the hookup. A 15′ 2″ (.66 times ½ wavelength) piece of 72 ohm coax is made into a loop and the outside shield is soldered together. (.66 is the velocity factor of coax. See April 73, p. 27 for details.) A similar 72 ohm coax from the output of the transmitter connects braid to loop broid and center conductor to one center conductor of the loop. This is, as is a balun, a re-entry transformer, effectively quadrupling the impedance of the line, which puts you at around 288 ohms. Close enough. The 300 ohm line is hooked to the center conductors of the loop as in Fig. 5. This, of course, is good for only one band—but what a simple device.

As might be expected, there are other ways to feed the bi-square. The chore is to transform the antenna impedance to the line impedance and then in turn match the line to the transmitter tank circuit. If you're feeling experimental, you might try a different method. Several are outlined in detail in the Handbook. I picked the quarter wave shorted stub system because of its simplicity.

As noted, this antenna is four half-waves in phase and a broadside radiator. There is a moderate null off the ends of this antenna. One interesting aspect is that despite the diagonal positioning of the elements, the array is horizontally polarized. In some quarters, this will be thought to be an advantage, especially when talking to the squad, beam, dipole group.

The mast used here is a simple "A" frame made of knotless, Douglas Fir. It is supported by nylon rope. The 40 meter bi-square I used a few years ago was supported by a 70 foot, steel tower. The air was full of steel guy wires and I had to string the bi-square elements between them. The successful use of both of these antennas would lead me to believe that you can use any available support, but probably a non-metal one is desirable.

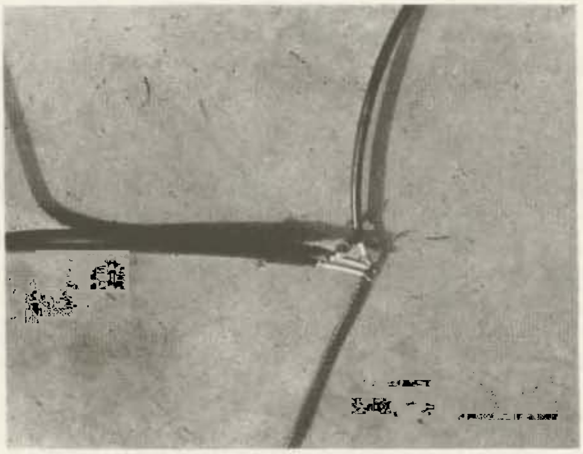


Fig. 5. Poor Man's balun. 72 ohm coax to the transmitter is at left, the balun loop is vertical in this photograph, and the 300 ohm twinlead is at right. All coax braids are connected. This system is sometimes used for matching feedlines to beams, but has been neglected in matching a transmitter to 300 ohm line—the use it's put to here.

If you already own a huge tower, by all means hang the bi-square as high as possible. In order to tune from the ground, you can use a ¾ wave shorted stub with nearly the same efficiency as a ¼ wave shorted stub. The same rule applies to this antenna as to all others—the higher the better.

It was mentioned earlier that two bi-squares could be hung on the same pole for 360 degree coverage. The only caution is that the stubs and feedlines do not parallel each other. Separate them by as close to 90 degrees as possible.

Now is the time to get out that old roll of

antenna wire and try something different. If you're burning with ambition, you might try putting a reflector on your bi-square. Space it at around 0.15 wavelength and tune it with a stub too. In fact, with a little ingenious switching, you ought to be able to make either element in your "reflected bi-square" the driven element, and thus have a "reversible, reflected bi-square." There's an 8.5 db conversation piece for you. As Fig. 2 attests, I don't have room for a reflector—but if I did, I'd be out there tuning right now.

The bi-square was introduced to me years ago by Jack, W8LIO, who has used this and hundreds of other "far-out" antennas. When I got my first 40 meter bi-square into the air and talked to South Africa with 100 watts of AM phone, I was sold. You will be too.

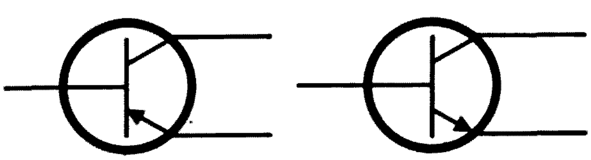
. . . W8GUE/6

Easy Method to Remember

Transistor Symbols

Many people, especially those not working daily with transistors, have trouble identifying and telling the difference between the standard PNP and NPN transistor symbols as shown in Fig. 1.

The direction of the arrow, of course, tells the difference. That is, whether the symbol represents a PNP or an NPN transistor. But this in itself can cause confusion, not to mention embarrassment, when the ole' memory fails. Use of a simple memory "hook," or associated mental picture will prevent such forgetfulness.



An excellent memory "hook" is one involving the positive and negative extremes of potential difference. When a difference of potential is visualized, ground potential is thought of as negative (N) and "down below" the positive (P) potential point. Likewise, the positive (P) potential point is thought of as "up above" ground. By picturing in your mind positive-P-up and negative-N-down and comparing this picture with the arrow direction of the transistor symbol, you will see that the arrow of a PNP transistor points *up* towards P, the first letter of the transistor type, and the arrow of the NPN transistor points *down* towards N, the first letter of this transistor type.

. . . W2VSP

Frank Merritt

The Drake Receiver

ALTOGETHER too seldom is a new receiver introduced that is really "state-of-the-art." The Drake 2-B receiver is an improvement of the 2-A, which was a modernization of the original 1-A model. All three incorporate many very fine principles of receiver design. Physically the receiver is quite small. Its dimensions are: 12" long, 7" high and 9" deep. Weighing only 14.5 pounds this receiver only uses 40 watts from the power line. This is significant since there is much less heat dissipated in this unit than many standard types of receivers. The top cover is made of perforated steel to aid in heat dissipation.

Circuit Operation

The block diagram in Fig. 1 shows the basic operation of the receiver. A 6BZ6 is used as a pentode rf amplifier. This tube exhibits semi-remote cutoff characteristics thus providing good control characteristics and low intermodulation. This stage is tuned by one dual control. As the BAND switch is positioned to the various bands additional inductances are switched across the basic tuned circuits allowing complete coverage of from 3.5 to 30 mc. Enough gain is provided by the rf amplifier to effectively mask any noise generated by the 1st mixer. The pentode section of a 6U8 is used as the 1st mixer. On all bands except 80 meters, this tube is operated as a mixer. When used for 80 meter operation, the oscillator is disabled and the pentode section of the 6U8 is used as a second rf amplifier.

A low-pass filter is used in the output section of this tube. This is used to prevent undesired mixed products being presented to the input of the *if* section. This filter is packaged as T1. The choice of a pentode-6U8 as the mixer is a good one. In any receiver most of the noise generated is created in the highest frequency mixer stage. The function of an rf amplifier is two-fold in that the rf amplifier must provide enough signal so that the noise of the mixer is not objectionable and selectivity at rf is also achieved. The basis for comparing tubes in terms of noise generation is that of comparing the equivalent noise resistances of the tubes involved. For instance, a 6BE6 exhibits a conversion transconductance of 475 micromahs which results in an equivalent noise resistance. Req, of about 230,000 ohms. The noise resistance is a function of the noise generated within the tube itself and is composed mainly of shot noise and partition noise. This figure of 230,000 ohms for the 6BE6, is compared to the 6U8 which is 9120 ohms. It will be noted that there is a very great difference between the two noise resistances. This relationship indicates that the 6U8 performs very well in mixer service at HF and VHF. This prediction is borne out in practice. A number of hams have dropped by to see the "new goodie." Almost every one has mentioned how quiet the 2-B sounds.

First IF Section

A frequency from 3500 to 4100 kc is presented to the first IF section. A 6BE6 is used as a combination variable frequency oscillator (VFO) and mixer. The output of the 6BE6 is 455 kc. Since the oscillator is variable, tuning is accomplished in this section. Since only one frequency range is converted by the oscillator and this frequency range is very low, 3955 to 4555 kc, unusual stability is made possible.

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Wes

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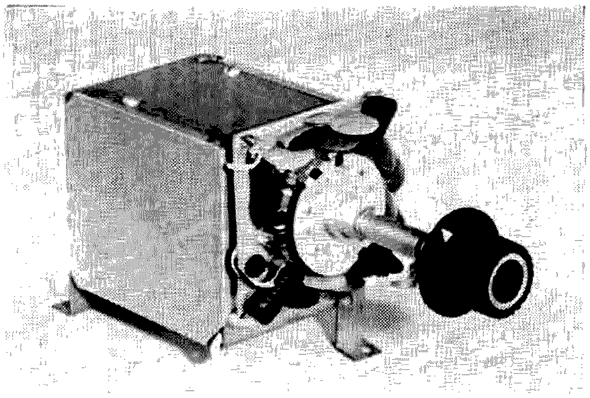


Great pains have been taken to result in an oscillator design that is extremely stable. In repeated experiments it has been found that the test receiver tested achieves 90% of its frequency stability in the first 30 seconds. This is well within the specification of less than 500 cps warmup and 100 cps thereafter. In fact, it has been noted that the warmup drift in a normally heated room is inconsequential. With this receiver, no longer is it necessary to indulge in long receiver warmup periods. It is significant to note that during sideband operation no drift is noted in normal operation.

Third Converter, Filter and IF Amplifier

The output frequency from the VFO-mixer circuit is 455 kc. This frequency is converted down to 50 kc for filtering. The tube used for this purpose is another 6BE6. The oscillator section of the 6BE6 is fixed-tuned at 405 kc. The output frequency, 50 kc, is presented to a passband filter/tuner. This is the heart of the 2-B and establishes the selectivity characteristics of the receiver. A switch lever selects bandwidths of 0.5 kc, 2.1 kc or 3.6 kc and a concentric shaft moves the passband, without changing its shape, above, through and below the fixed BFO frequency. This combination works wonders on CW, SSB and AM.

On CW, with a crowded band like the Novice portion of 40 or 80, put the lever in the .5 kc position and you can select and separate any signal out of a possible 10 or 15 just by tuning around with the passband tuning knob.

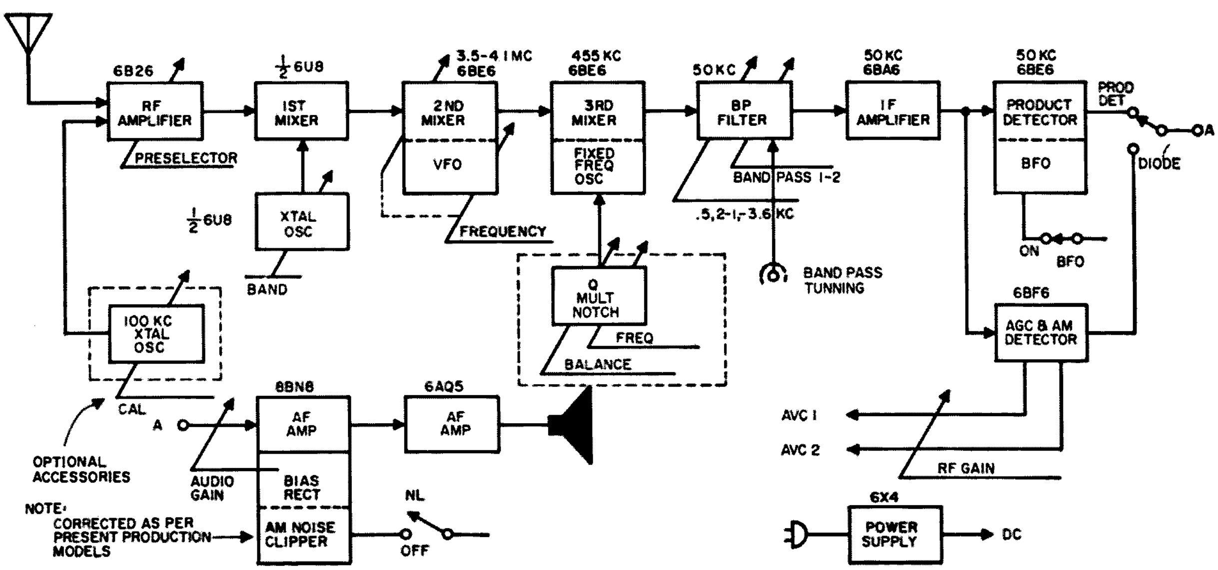
Normal SSB reception is made with the lever in the 2.1 kc position, though it can be copied in the .5 kc position when the QRM gets rough. You can get "hi-fi" SSB with the switch in the 3.6 kc position and the skirts on this new filter are steep enough for good unwanted suppression even in the wide position. At any bandwidth the passband tuning knob permits selection of upper or lower sideband and adjustment of voice quality without retuning the frequency.

The 3.6 kc bandwidth is just right for AM. However, if receiving conditions become unbearable due to interference or selective fading, switch on the product detector and cut the bandwidth to 2.1 kc or even .5 kc!

On the remote chance that someone might want even more selectivity Drake has a combination loudspeaker and Q-multiplier available as an accessory. Adding the action of the Q-multiplier and the passband filter you get such a sharp notch that it can separate almost anything. The Q-multiplier is much more valuable when used in the notch position. Reception through almost any ham band bedlam is possible. The Q-multiplier may also be used as a notch filter for phone operation. After the *if* filter an *if* amplifier is provided to raise the level of the signal to be suitable for detection. This amplifier uses a 6BA6. The S-meter circuit is in the plates of the *if* and rf amplifiers. A bridge-type circuit is used with a 100 microfarad capacitor shunting the meter for critical damping.

Detector

One of the strongest points of this receiver is the product detector. A 6BE6 is used as a



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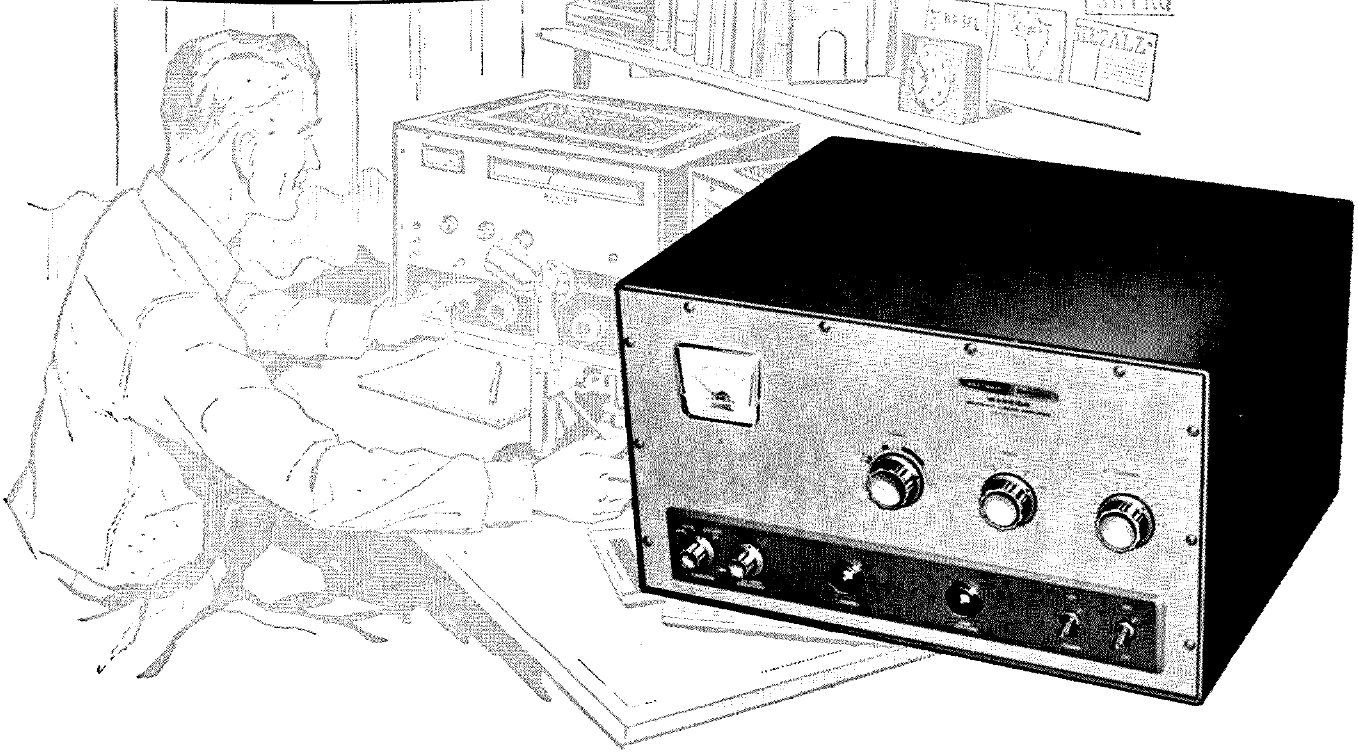

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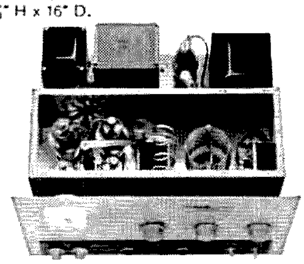
Maximum power input: SSB—1000 watts P.E.P., CW—1000 watts, AM—400 watts (500 watts using carrier controlled modulation), RTTY—650 watts. **Driving power required:** 50 to 75 watts—depending on frequency. **Output circuit:** Variable pi-network (50 to 75 ohms). **Input circuit:** Broad banded—requires no tuning. **Input impedance:** Approx. 70 ohms. **Band coverage:** 80, 40, 20, 15, 10 meters. **Panel metering:** Switch-selected, grid current, plate current, high voltage and relative power output for ease of loading. **Tube complement:** 4-811A, 2-866A. **Size:** 19½" W x 11⅝" H x 16" D.



This inside view shows the neat circuit layout and husky components that emphasize quality. Note the internal shielding of plate circuit for maximum protection against TVI.

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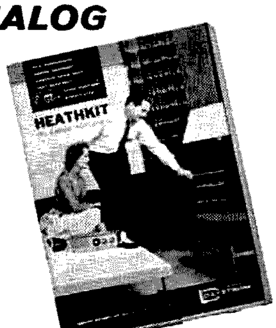

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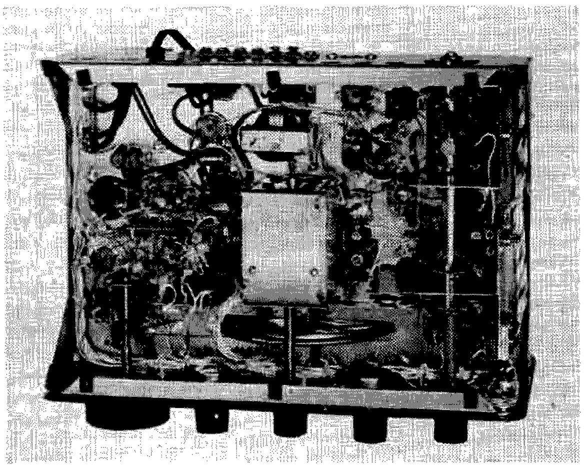
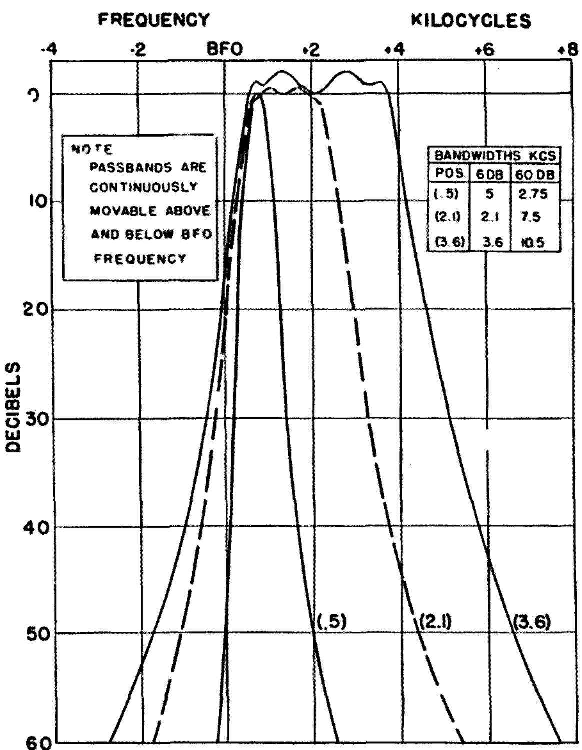


product detector and BFO. No provision is made for tuning the BFO. This is indeed a radical change from conventional circuits. Let us, for a moment, analyze the two usages of the BFO. First, the BFO is used to create a beat frequency when the BFO is heterodyned against the CW signal. This example may be thought of as two frequencies beating against each other to result in an audio tone when the received CW signal is present. In using this receiver for CW, it is necessary to select the desired tone by the main tuning dial and then positioning the PASSBAND control for the desired operation. In order to achieve single-signal selectivity it is usually most convenient to present the PASSBAND control to either 1 or 2. This action selects the upper or lower sideband of the heterodyne. Strong adjacent channel interference can usually be eliminated by carefully tuning the PASSBAND control to drop the interfering signal off the edge of the passband. When the Q-multiplier is used, the selectivity is increased very greatly. In peak operation the Q-multiplier provides a frequency selective boost of 20 to 30db.

The second usage of the BFO is as a reinserted carrier oscillator. The reinserted carrier provides a signal for the sidebands to heterodyne against thus producing the original audio modulation. The PASSBAND control selects the sideband that is used to heterodyne against the reinserted carrier. The advantages offered by a product detector are twofold. First, the amplitude of the incoming signals, sideband intelligence, does not have to be matched against a fixed amplitude of BFO to result in a condition of 100% modulation. Since the process of detection is one of frequency conversion only enough signal to cause a heterodyne is necessary. Secondly, only the audio products are heard in the output and no other signal or signals have any control in the output. In diode detectors it is common for a strong signal, that may be 10 or 20 kc off-frequency, to capture the detector and block it. This is impossible in a product detector due to the basic nature of the frequency conversion process. With ALL types of modulation it is possible, with this receiver, to turn the RF GAIN control to the full CW position (maximum sensitivity) and leave it there. In fact, for all practical purposes don't bother with it. The AF GAIN control is all that is needed to control the output of the receiver.

A diode detector is provided for the reception of AM signals. This is a common type of circuit and will not be discussed in detail. It will be found that the PASSBAND control is a boon even for AM. A common situation is that interference may be predominate on one sideband but not on the other. In this case it is only necessary to tune the sideband that has the least amount of interference. And best of all—this principle really works to wonderful benefit in this receiver. The more discriminating users will be somewhat unhappy about the limitation of fidelity which results from the bandpass of 3.6 kc. It should be remembered that this receiver is not designed for High Fidelity. Its purpose is communications and toward this end some "fidelity" is intentionally lost.

Both the AM dectector and the AVC detector circuits are fed from an amplifier stage. This is provided primarily to compensate for the relative inefficiency of the AM detector and to provide additional amplification prior to the AVC rectifier. A network in the output of the AVC detector is provided to allow "fast attack and slow decay" action. A discharge time of 0.05 second is provided in the fast AVC position (F. AVC). This time is lengthened to 0.75 second in the slow AVC position (S. AVC). The longer period is usually preferred at this station since it allows a small



SELECTIVITY CURVES

period of time before maximum sensitivity is restored. A terminal is provided on the rear of the chassis to provide additional capacitance to increase the decay period. In the STBY position, the STDBY-RCV switch permits full negative bias voltage to be provided to the AVC controlled circuits thus muting the receiver. Access is provided at the rear of the chassis so that this function can be provided by an external circuit such as a switch or relay.

Audio

Post detector amplification of the audio signal is provided by a 6AV6 triode amplifier. It should be noted that in the output of the product detector there is a low-pass filter that has a 3-kc cutoff frequency to further limit the high frequency response of the product detector. The power output stage is a 6AQ5 in a conventional-type circuit. The audio output is available at the front of the receiver at a phone jack. When headphones are plugged into the jack, audio power is automatically removed from a loudspeaker that may be connected to terminals on the rear of the chassis. While not overwhelming, the audio output is adequate for all normal purposes. If additional power is desired, for some reason, little problem is presented in connecting an auxiliary power amplifier to the receiver.

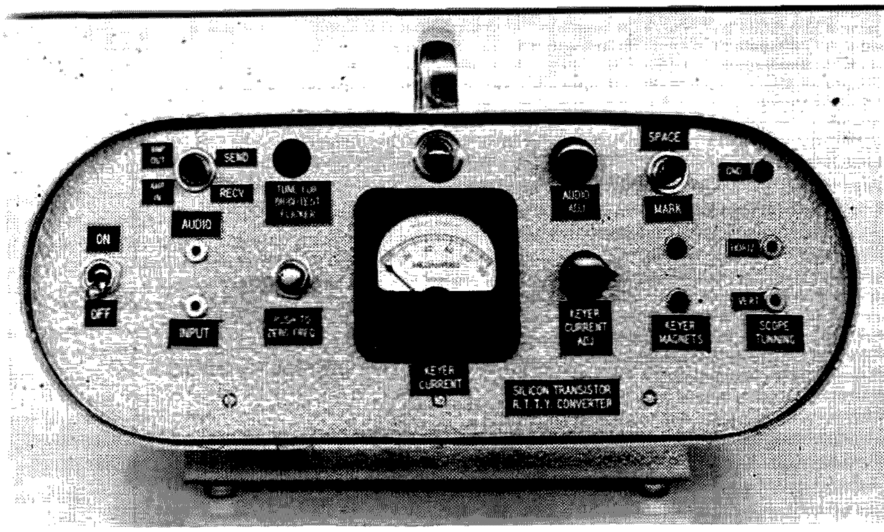
Summary

The *if* skirt selectivity of this receiver is almost as sharp as that provided by mechanical filters or crystal filters and is a pleasure to use. The stability factor is of the highest order. In general, this is undoubtedly one of the finest receivers to be produced for the Amateur market. It has been a very pleasant discovery to find that the PASSBAND control functions just the same as the bandpass tuning control on the Collins 75A-4. The serious CW operator will be completely satisfied with the selectivity, but, again, complete satisfaction is a matter of several hundred dollars more.

Recent correspondence with the factory has disclosed that a noise limiter can be installed and recent production modifications added for the nominal sum of $15. It is expected that these changes will be incorporated in future models of this very fine receiver.

It should be noted that any small non-linearity in tuning can be corrected, in a limited range, by sliding the dial glass with a pencil eraser. No attempt was made to design the tuning mechanism as a frequency meter. For virtually all operating requirements the calibration of the dial is unusually good.

All four units checked by the author have indicated good consistency of manufacture. In summary-summary, this receiver is very highly recommended as an excellent communications receiver.



J. R. "Bob" Barbay W5SFT
6811 Toland St.
Dallas 27, Texas

All Silicon Transistor

RTTY Converter

MANY articles have been published about radioteletype converters (TU's); the newcomer should be getting thoroughly confused, so let us help by putting another in the pot.

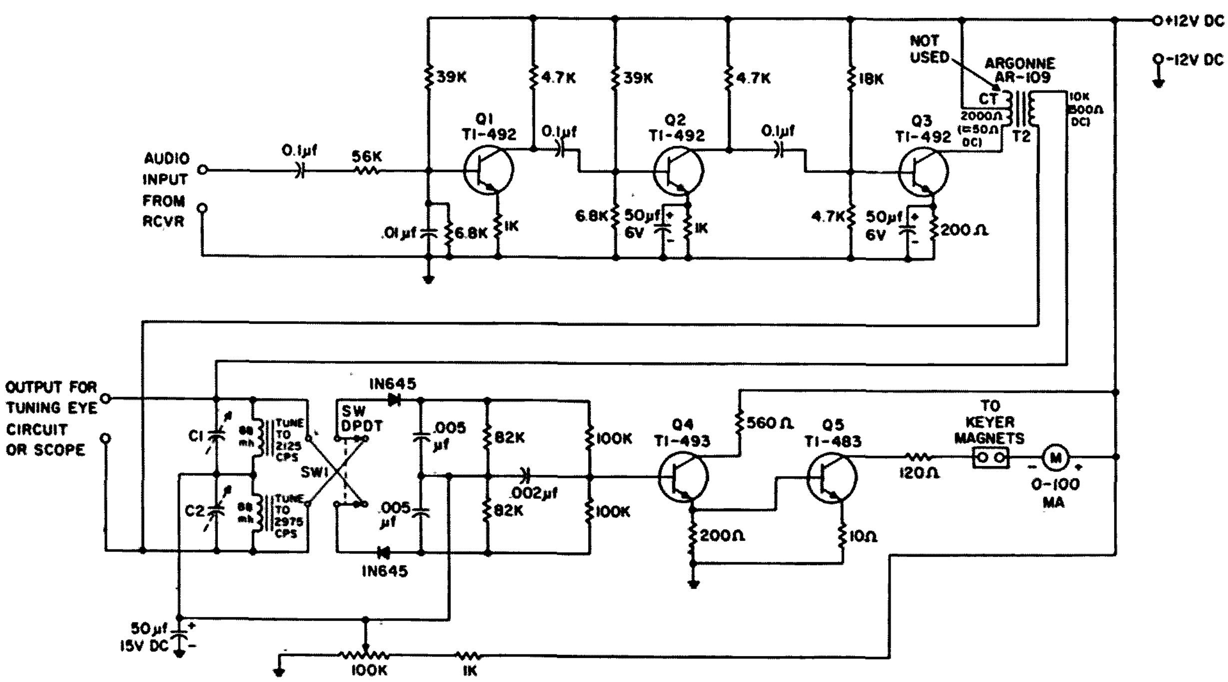
We have all decided that a TU should be as simple as possible to build, adjust, and cost as little as practicable. The TU should be usable on a.f.s.k. or f.s.k. It should have provisions for filters such as bandpass and/or narrow shift, it should provide for some sort of tuning indicator (meter, oscilloscope, or tuning eye), a provision for auto-start, and an a.f.s.k. oscillator for v.h.f.

Next we should decide what type TU would best meet most of these conditions.

The a.f.s.k. seems to be the best suited for versatility.

The silicon transistor is a good type of device to handle the current that we will be working with, about 200 ma, so the cost becomes practicable. The voltage, being low (12 v dc), makes other components cost very low, as we can work with ratings of less than 100 volts.

The building is simple because the TU is built on a printed circuit board, which is available at a small cost.



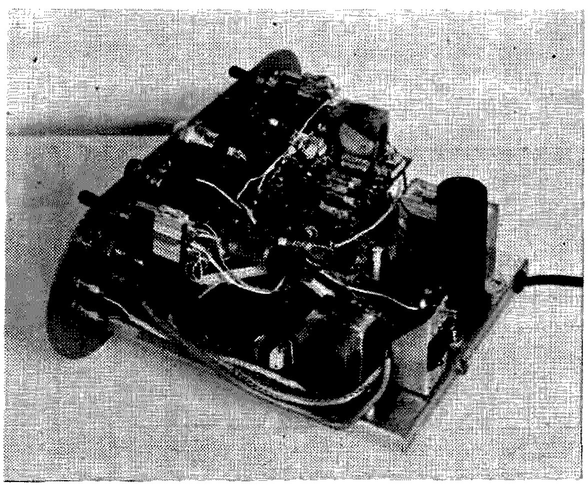
Schematic of converter. C1 will use approximately .068 mfd to tune to 88 mh choke to 2125 cycles. C2 should tune to 2975 cycles with about .033 mfd. T2 can be a Stancor TA-35, a Thordarson TR-7, or an Argonne AR-109.

The adjusting is simple, because you only need an audio oscillator, and V.T.V.M. to adjust the two 88-mh toroids. (These toroids or telephone loading coils are available from Jack Pitts W6CQK at a cost of $1.00 each postpaid, or Irving Electronics Co., P.O. Box 9222, San Antonio 4, Texas.)

An L-C filter or bandpass amplifier can be added to the front of the converter to improve reception when there is heavy QRM. A bandpass amplifier is at present under construction on a printed circuit board and will be described in a future article.

The provisions for tuning have been made for an oscilloscope, a tuning eye, or frequency meter. The frequency meter, and the oscilloscope will be on printed circuit boards, and are under construction also.

The circuit construction is simple. The schematic that comes with the circuit board has numbers in a circle for each lead of the component, these numbers will match hole numbers on the printed circuit board for leads to be soldered. There are six holes for as many as three capacitors, to tune each of the 88-mh toroids for the standard 850 cycle shift, the



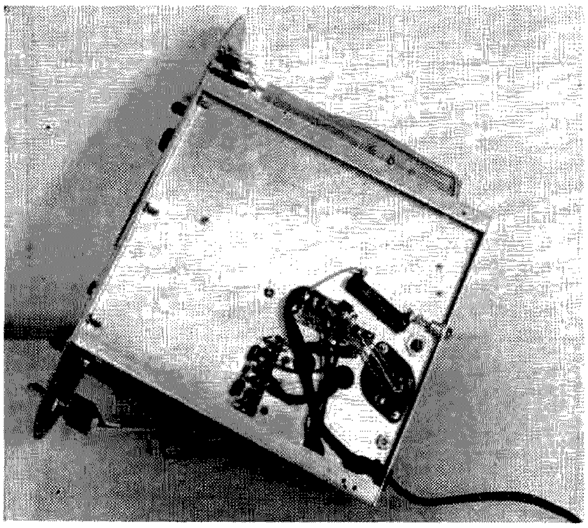
space filter is tuned to 2975 cps. This takes a total capacity of about 0.033 mfd, and about 0.068 mfd capacity for 2125 cps for the other toroid. We may note here that when tuning these two toroids they should be mounted on the board and in the circuit. An audio signal is applied to the input at the frequency each of the toroids is to be tuned to. Watch for a peak on a V.T.V.M. across the toroid being tuned. NOTE:

Use only mylar, mica, or paper capacitors. Do not use disc ceramic capacitors.

The input circuit shown is an RC type input into the base of the first transistor. A transformer may be coupled between the output of the receiver to match the input impedance of the converter. None is shown here because we are working on an emitter-follower bandpass filter. Though the converter works very well

(Turn the page)

(RTTY from page 25)



with four ohm input from the receiver, it will work much better with a matching transformer of four ohms to twenty thousand ohms into the converter.

The output of the converter is placed in series with the local loop. The output transistor acts as a switch, or relay, and does away with the polar relay.

PARTS NOTES

All parts are available from your local scrap box, or your local dealer. The transistors and diodes are Texas Instruments, Inc., obtainable at your local TI distributor. These silicon transistors are the industrial type and do a real good job for a reasonable price.

The prices are as follows:

TI-492	$2.35 each
TI-493	2.55 each
TI-483	4.20 each

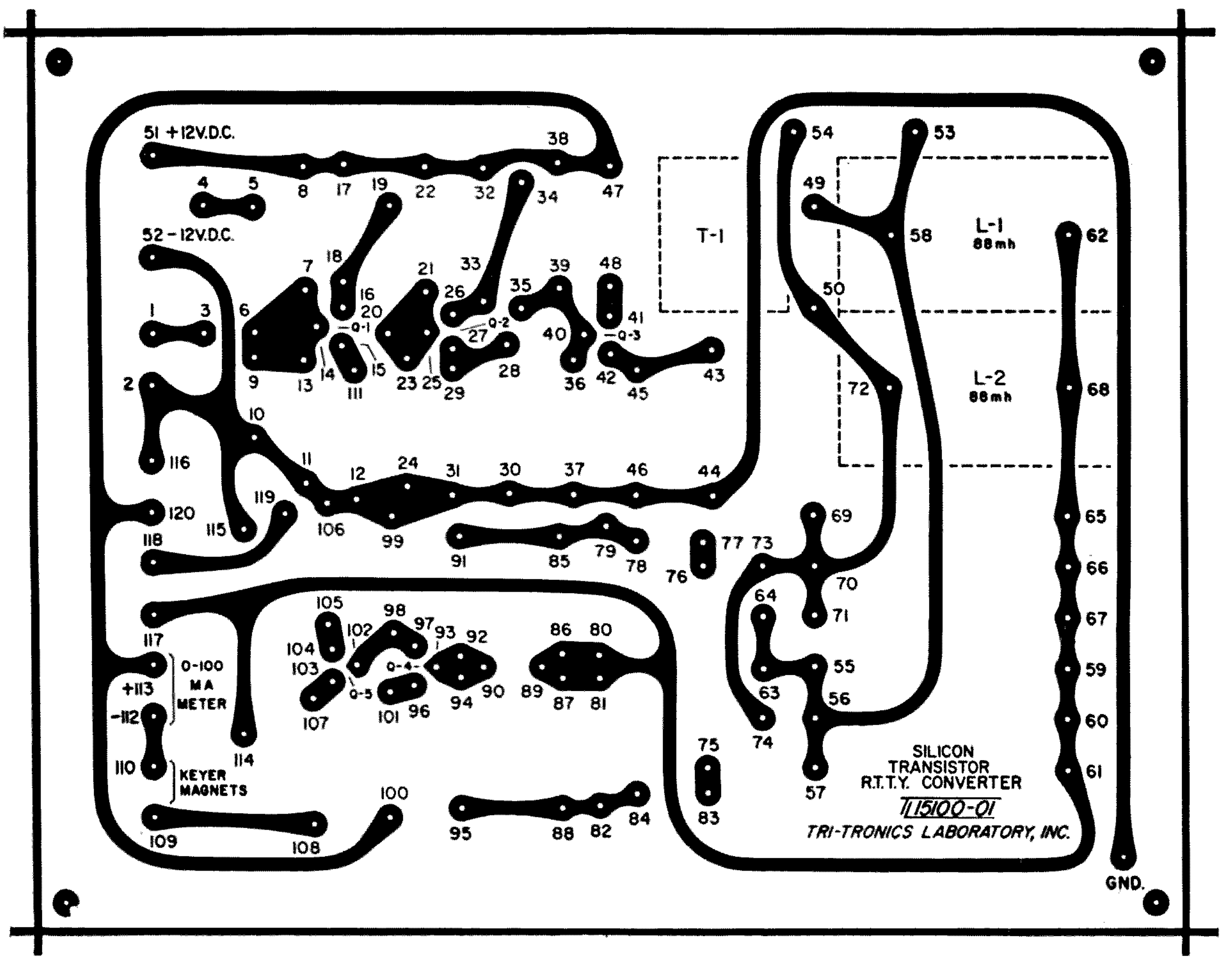
The toroids, or loading coils can be obtained from several places other than those listed in the parts list.

Jack Pitts W6CQK, 1307 Alemeda, Redwood City, California, can supply a complete plug-in filter unit for $3.50 each, postpaid. These units may be mounted off the printed circuit board, and wired into the board. This way you may want to build a tube type, and transistor type, and see how the two compare.

The printed circuit boards, and all instructions can be obtained for $2.00 p.p. from Tri-Tronic Lab. Inc. (part number TL-15100-01) P.O. Box 238, Euless, Texas, or though most of the dealers who stock Texas Instruments, Inc. industrial type transistors.

. . . W5SFT

Printed Circuit—Shown Full Size

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Two Meter Nuvistor Converter

Larry Levy WA2INM
1114 East 18 Street
Brooklyn, New York

THE fact that nuvistors are available at a very nominal cost invalidates any excuses from two meter operators for not having a low noise converter. Even the cascode circuit is now practical though a year ago a cascode converter using 417-A's was out of reach of most amateurs.

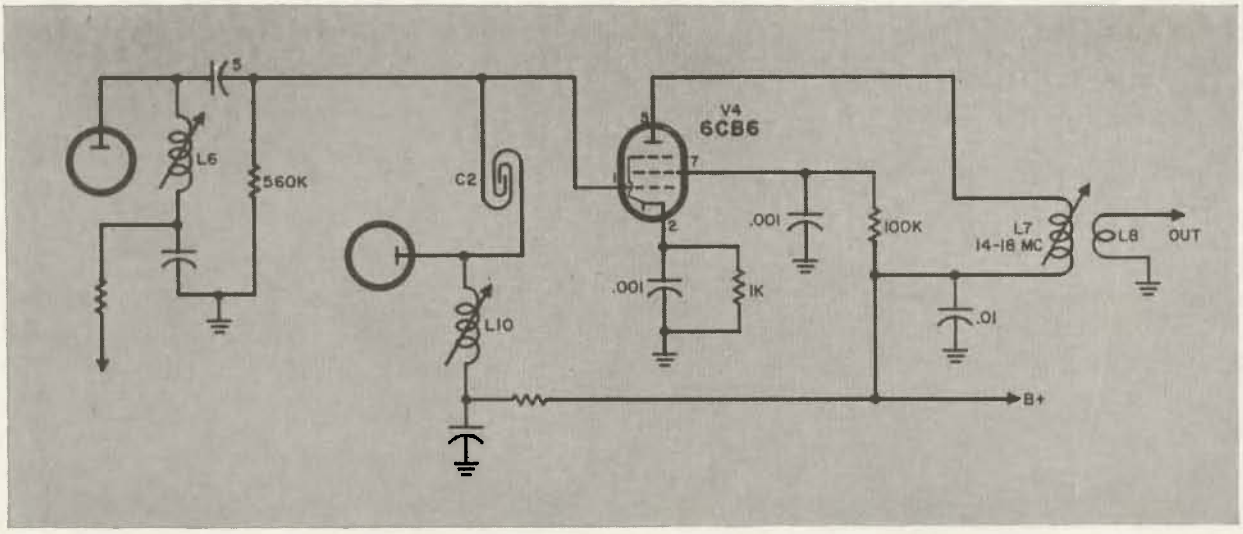
The advantages of the cascode circuit are many. One major advantage is the relative ease of neutralization. This is a blessing, as anybody who has spent hours cursing at a neutralization coil in a triode rf amplifier, such as one using a single 417-A, or any other high transconductance tube, will testify.

After reading pages of praises to the Nuvistor, I went out and purchased a small pile of them, including some of those elusive sockets. The design of the converter in its original form was quite different from the finished product, in which all the values were adjusted for the best signal to noise ratio. The converter uses only triodes. Having had some experience with pentodes in low noise converters, I figured that a lower noise converter could be made without them. After the unit was completed and working, I tried substituting a 6CB6 for the mixer. I found that while it had little effect on the noise figure, there was an improvement in the overall gain. This will be an advantage to those whose receiver lacks spare gain.

For the most stable operation all the coils should be shielded from each other, as even the small amount of regeneration, caused by feedback, will raise the noise figure. A beer can is an excellent source for shields, and a 12 oz. can will provide all the shields you need.

The circuit used is a double cascode. This provides plenty of gain with very little noise. The first cascode uses a pair of 6CW4's, capacitively coupled to the following cascode and neutralized by L2. The tap on L1 and the setting of C1 will have a great deal to do with the overall noise figure of the converter. A 5 turn coil was used, with the best tap position being about 2 turns from the grounded end. A turning wand, which is a plastic rod having a brass slug on one end and a powered iron slug on the other, will be a great help in aligning and neutralizing the converter. The one I used was a GC 8278. This has a diameter of slightly more than ¼" and was used as a winding form for L1, L2, and L5. This made it easy to adjust those coils by slipping the wand into the centers of the coils. L3, 6, 9, and 10 are wound on ¼" slug-tuned coil forms. L4 is an Ohmite Z-144 rf choke. A 250k resistor can be substituted, with very little, if any, loss of performance.

If you are going to use the range of 14 to 18 mc for the *if* the crystal frequency and the frequency of L9, L10, and L7 can be used as given. For other *if* frequencies they will have



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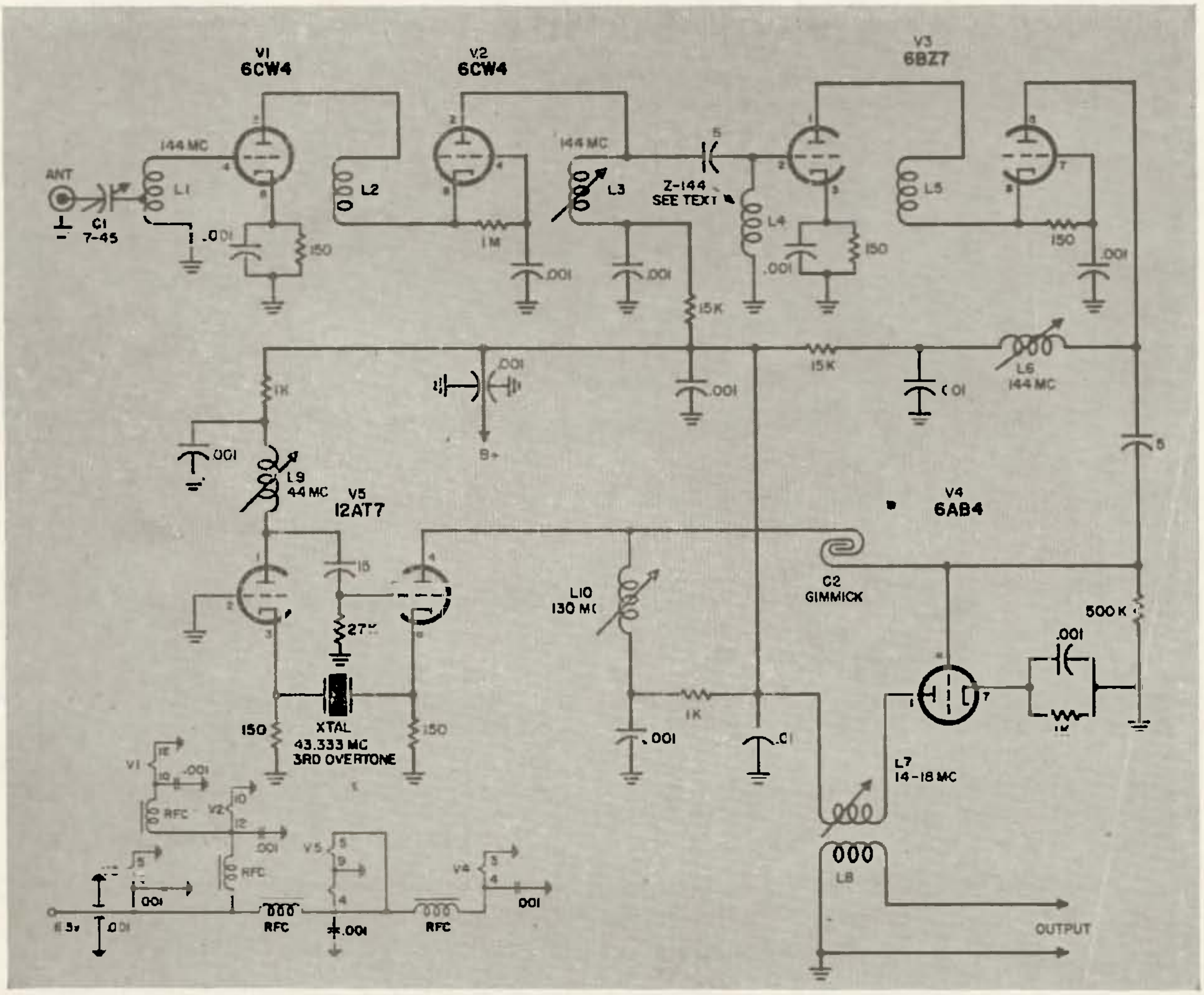
to be changed accordingly. One possibility might be the use of a 50-54 mc *if* for receivers like the HQ170 or other ham-band—only receivers that cover 6 meters. This would give you the necessary 4 mc spread to cover the two meter band. For a 50 mc *if*, use a 47 mc crystal and tune L10 to 94 mc, doubling in the multiplier instead of tripling. L7 is tuned to 50 mc with L8 being 1 or 2 turns.

Gimmick C2 is made by twisting two 1" pieces of insulated wire together. The only precaution necessary in laying out the converter is to make sure that the chassis is divided well with a shield to prevent any of the oscillator fundamental from mixing with the two meter signals, especially in the early stages. The rf chokes in the filament leads are an FT243 crystal socket, with a Butler oscillator it is possible to mount the crystal socket in this manner. It also has the advantage of having no leads on the crystal socket.

After wiring is complete the next thing to do is to check for errors and test out the converter. The B-plus required is between 150 and 200 volts. Tune L9 to the crystal frequency and adjust for maximum output using a grid dip meter. Do the same for L10. If you are lucky with the settings of the rest of the coils you will probably be able to hear some strong local signals at this point. If not, adjust the coils to a signal from either your own transmitter or some other source. Neutralization is accomplished by removing plate voltage from the rf stage being neutralized and ad-



made from 10 or 15 turns of fine enameled wire, wound on a high value 1 watt resistor.

For stability, a modified Butler oscillator was used. Another reason it was used was that, because of an error on my part, I had neglected to drill holes for the crystal socket. Since I was using a 12AT7 I could get away with mounting the crystal socket underneath the tube socket, held in place by a 4-36 screw and bolt through the center hole of the 12AT7 socket. Since pins 3 and 8 are opposite each other and of the same spacing as the pins on justing the coil for minimum feedthrough. The tuning wand will be helpful here. If the feedthrough decreases with the brass slug, spread the turns on the coil. The opposite goes if feedthrough decreases with the iron core. L1 is adjusted to resonance by the same procedure. After the converter is aligned properly it should have quite a low noise figure. To get optimum, a noise generator should be used. The settings of C1 and the tap and tuning of L1 will have a major effect on the noise figure and should be adjusted very carefully.

If you live in an area where there are very strong locals, cross modulation may be experienced. It might be helpful to lift the cathode resistor of V3 off ground and connect it to a 5K pot. Triode mixers overload less easily than pentode mixers.

The results from this converter have been excellent. No problems were experienced with images or spurious responses. The converter was well shielded, being built on a 3" x 4" x 5" Minibox. Feedthroughs were used for B-plus and filament leads.

The overall cost of the converter was less than some of the more popular converter kits and the performance exceeds any of them. The converter has been in use for a period of time and has the ability to really dig out the weak ones. . . . WA2INM

Coil Table

L1—5 turns #20 bare wire wound on ⅜" form spaced 1'. The coil is tapped 2 turns from the grounded end.
L2—6 turns insulated wire wound same as L1.
L3—3 turns #20 wire wound on ¼" slug-tuned form.
L4—ohmite Z144.
L5—8 turns wound same as L2.
L6—same as L3.
L7—depends on output frequency.
L8—2-4 turns insulated wire wound over L7.
L9—approximately 15 turns of insulated wire on ¼" slug-tuned form. The exact coil will depend on the crystal frequency used.
L10—depends on if used.
Note: All slug-tuned forms use ferite cores.

Almost Universal Rectifier Sockets

It is very annoying to find that a rectifier tube has gone bad on a Sunday afternoon while working a new state or country and there is no replacement in the house. There are usually several other types of rectifiers available but they have different pin connections. The base connections on most of the 5v rectifiers fall into three general groups. Each one is different from the other by just a small change. When constructing equipment, it is easy enough to make the low voltage rectifier socket almost universal by the addition of 3 jumpers. Connect pins 3 and 4 together for one plate, pins 5 and 6 for the other plate, pins 2 and 7 for one side of the heater and take the high voltage off pin 8, which is the other side of the filament. After these changes are made, it is possible to substitute different types, providing none of the ratings are exceeded. A socket wired in this manner will accept the following type tubes; 5AU4, 5AW4, 5AS4-A, 5R4GY/A, 5T4, 5U4G/A/B, 5V3, 5V4GA, 5W4GT, 5X4G, 5Y3G/GT, 5Y4G/GT and 5Z4.

. . . WA21NM

Versatile Control Techniques

Use of TV Replacement Components Can Help Salvage the Resale Value of Your Modified Equipment and Permit More Compact Layout in New Construction.

Roy E. Pafenberg W4WKM
709 North Oakland Street
Arlington, Virginia

THE average amateur, when faced with a problem of equipment construction or modification, thinks in terms of the conventional, single gang variable resistor or control. Use of dual, concentric shaft controls and the new push-push or push-pull control switches which make switch action independent of control shaft rotation can simplify construction, save time and effort and permit more compact arrangements in construction projects. These new components, developed for the mass entertainment equipment market, can go a long way in reducing the butchery normally associated with modification of manufactured or home constructed equipment. Nothing reduces the resale value of communications equipment so much as a few extra, randomly spaced holes chewed through the front panel.

Equipment modification calling for the addition of a variable resistor can best be accomplished by replacing an existing single potentiometer with one of the concentric shaft, dual units. The concentric drive assembly consists of a ¼" hollow shaft which drives the front section of the control and an inner, ⅛" or $\frac{3}{16}$" shaft which drives the rear unit. Most control manufacturers make these resistors for the television replacement market and they are available as exact replacement types or as "on the job" assembled components. The controls made up from stock parts are better for this purpose since the shafts will probably have to be cut to the proper length.

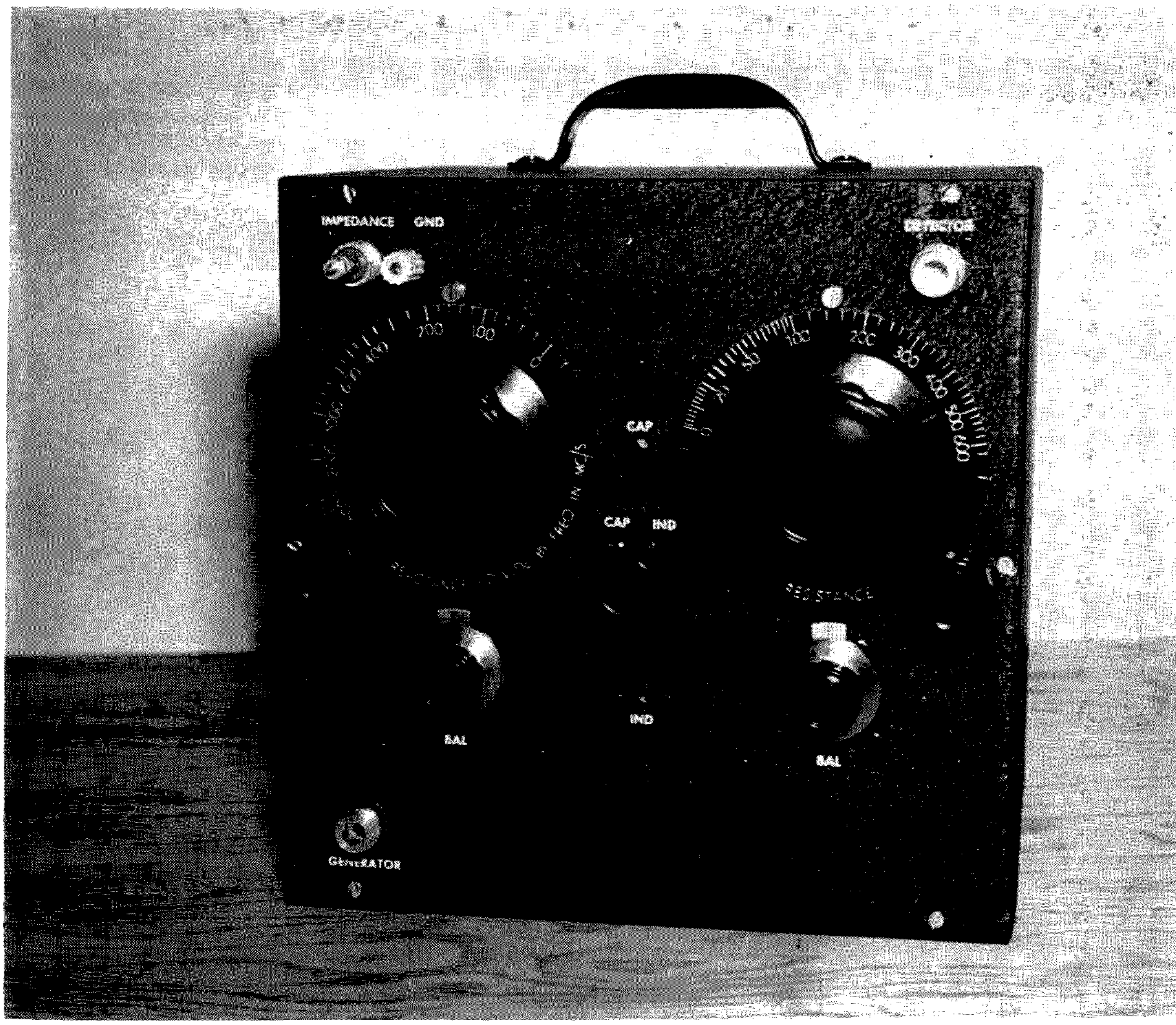
One manufacturer, to ease the shaft cutting task, makes available an ingenious and convenient shaft cut off jig. These are stocked by the jobbers that handle the line of controls. It will often be possible to have the shafts cut to the proper length and the control assembled for the cost of the component parts. If not, it is a simple task with hand tools and well worth the effort. The resistance elements are available in a wide range of values and tapers, so getting the right combination to meet your exact requirements should be easy.

A source of knobs for the dual controls is a slightly more difficult problem. Most available sets are decorative creations scarcely suited to the functional motif of communications equipment. In addition, knob springs are usually employed to rather insecurely fasten the knob to the shaft. The requirement is for a set screw type knob set of color and configuration to match the usual communications equipment knobs. Allied and Newark catalogs list a 1¼" diameter, Harry Davies knob set Number 1915 which will prove suitable for most applications. Matching, black Bakelite single knobs are available in ¾", 1¼" and 1½" diameters. Alternatively, an existing, flat top knob can be drilled through and used for the ¼" shaft and a harmonizing, if not matching, ⅛" bore knob used for the center shaft. It may be necessary to drill out the ⅛" shaft hole to a nominal $\frac{3}{16}$" to fit most controls. A suitable combination for new work is the National type HR and the Millen Number A006 dial.

Much communications equipment uses control mounted switches to perform various functions. Special purpose use and modes of operation not contemplated by the manufacturer often make it desirable to have switching capability independent of control rotation. The new push-pull and push-push control and switch assemblies make such isolation easy since the switch can be actuated at any setting of the control. Equipment modification calling for the addition of a SPST switch may be easily accomplished by replacing an existing single section variable resistor with one of the new assemblies. The cost is low and there is no hole drilling involved. Typical of the push-pull switch-controls is the Mallory type PP. Values range from 1,000 ohms to 5 megohms, with some resistances available in both audio and linear taper.

Few precautions are necessary in applying the techniques outlined, although care devoted to functional grouping of the dual controls will pay off in operating convenience. There is little cross-coupling between sections of the dual controls and normal attention paid to lead dress and shielding will minimize circuit interaction. Use of the control assemblies described will eliminate hole drilling in many equipment modifications and under these circumstances, restoring the equipment to normal for sale or trade is a simple task. Give these new components a try. They will save you work and money.

. . . W4WKM



The Mark III RF Impedance Bridge

L. A. (Mark) Cholewski, K6CRT, ex-W8SVK
110 Camino de las Colinas
Redondo Beach, Calif.

NEED to measure the input impedance of that new beam? Or maybe to find out just what is the Q of the coils in your final? Or even to determine how much signal is being soaked up by your coax? If you ever want to do these, or any similar jobs, then the Mark III RF Impedance Bridge is the thing for you.

You can build it for a total cost of about $30 (exclusive of sheet metal) and, if you follow instructions closely, it will be accurate to closer than 10 percent throughout its operating range. Unlike the more common resistive-bridge and reflectometer methods of measuring impedance, the Mark III operates equally well at resonance or far away. It will measure both resistance and reactance present in resistors, capacitors, inductors, antennas, and transmission lines at any frequency between 2 and 30 mc.

Before we start into the actual construction of the Mark III, one thing must be emphasized. Accuracy can be assured only if the components, circuit, and parts layout are absolutely duplicated. The original instrument's calibration was obtained through tedious laboratory techniques. If you make any changes, the calibration curves will no longer apply. However, if instructions are followed to the letter you need have no worries about accuracy. A test model, built by W6BJU following these instructions, checked out to 2 percent accuracy at 2 mc and 10 percent at 30 mc.

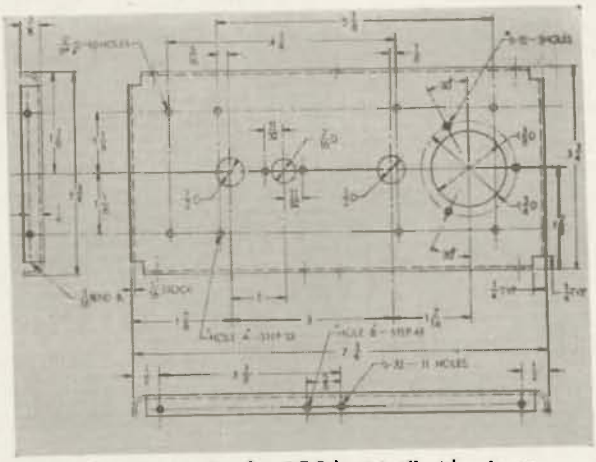
Construction of the Mark III divides into three major sections: Preliminary metalwork, actual wiring, and calibration. Each will be described separately. Ready? Let's go!

Preliminary Metalwork

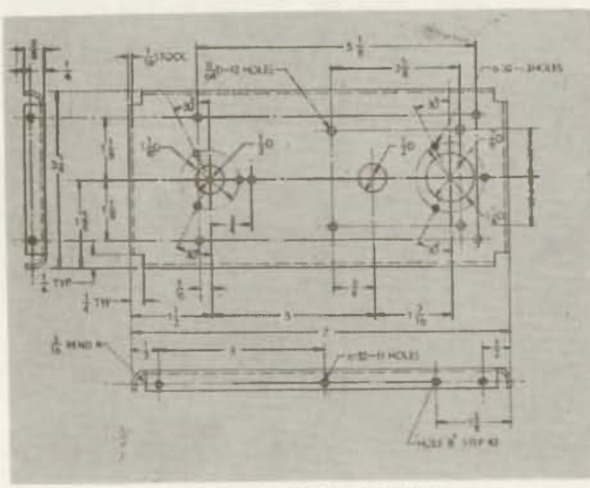
1. Cut, drill, and bend to shape from soft aluminum shields S1, S2, and S3 as shown in Figs. C1, C2, and C3.
2. Cut, drill, and tap plexiglas insulators I1, I2, and I3 from bulk rod stock as shown in Figs. C4 and C5. When tapping plexiglas, use water as lubricant.
3. Cut, drill, bend, and solder tubular shields S1A, S2A, and S3A as shown in Fig. C6. Copper or brass may be used; aluminum should be avoided because of solding difficulties.
4. Assemble shielded resistor assembly R2/S4 as shown in Fig. C7. The copper tubing must be drilled out to clear the body of R2. When soldering, hold the assembly in a vise to protect R2 from excessive heat.
5. Cut, drill, bend to shape, and solder box shields S1B, S2B, and S3B as shown in Fig. C8.
6. Drill S5 (a 3x4x6 LMB unpainted chassis box) as shown in Fig. C9.
7. Cut, drill, and bend to shape shield partition S5A as shown in Fig. C10.

Shielded Transformer

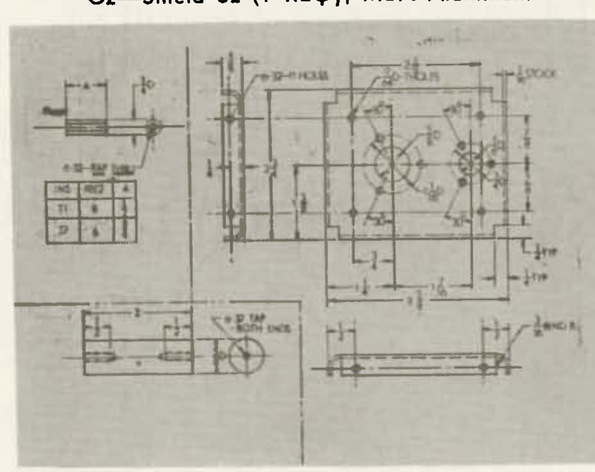
While classified under the "preliminary metalwork" section for reasons which will become obvious, construction of the shielded transformer is the most critical part of the entire project. Before proceeding, read and re-read steps 8 through 24 and be sure that you understand them fully. Take special care when soldering—three transformers were built



C1—Shield S1 (1 REQ). Mat'l Aluminum



C2—Shield S2 (1 REQ). Mat'l Aluminum



C4 — Insulators. Mat'l Plexglas rod

C5 — Insulator I3 (8 REQ). Mat'l Plexiglas rod

C3—Shield S3 (1 REQ). Mat'l Aluminum

for the original instrument before a non-shorted one was achieved.

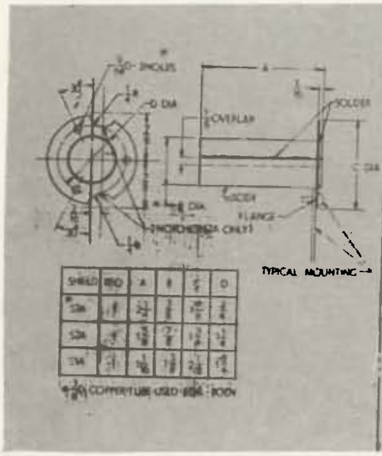
8. Cut to length, drill, and tap transformer mounting insulator 14 from 5/16-inch plexiglas rod.

9. Cut and drill two bobbin-end washers as shown in Fig. C12 and solder them to a length of copper tube as also shown. Then cut halfway through the bobbin with a hacksaw.

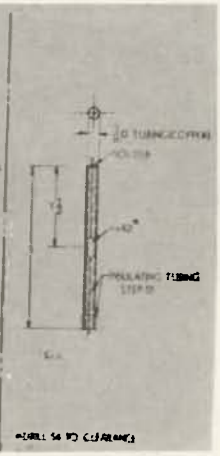
10. Pull the shielding from an 18-inch length of RG58/U. Save 8 inches for step 19 and use the rest in step 11.

11. Solder one end of the 10-inch shielding into the U-shaped slot on the bobbin end, using an aluminum rod or small drill to keep the inside of the shielding open. It must pass No. 26 plastic-covered wire. Clean off all metal burrs and solder splatters.

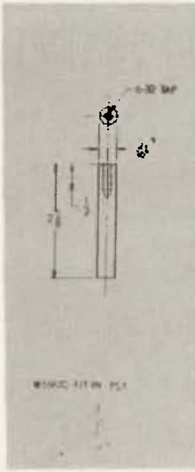
12. Wind 48 turns of No. 26 plastic-covered hookup wire on the bobbin in three lays of 16 turns each. Solder the start of the winding at



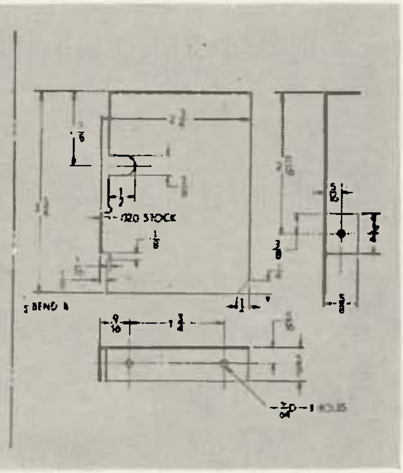
C6—Tube shield, Mat'l .010 Brass



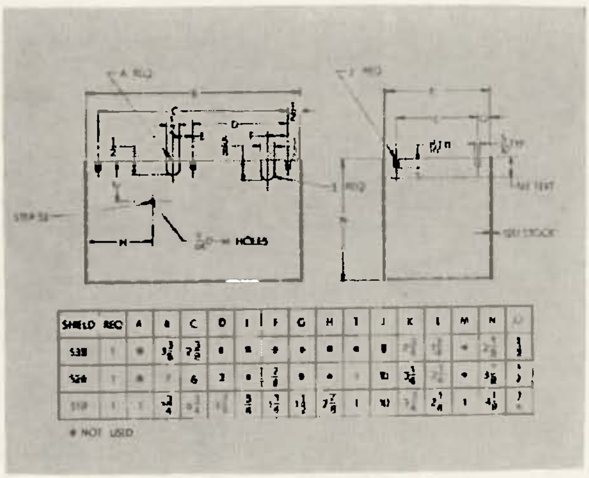
C7 — Shield Assembly S4



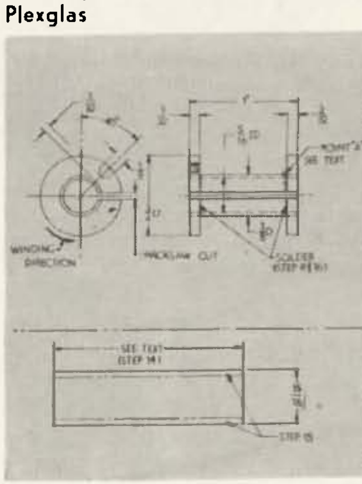
C11 — Insulator 14, Mat'l Plexglas



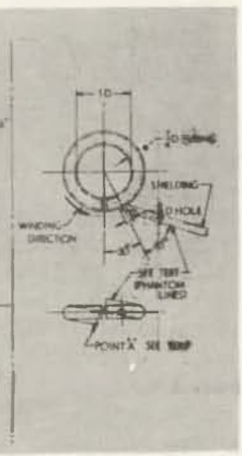
C10—Shield Partition S5A, Mat'l Aluminum



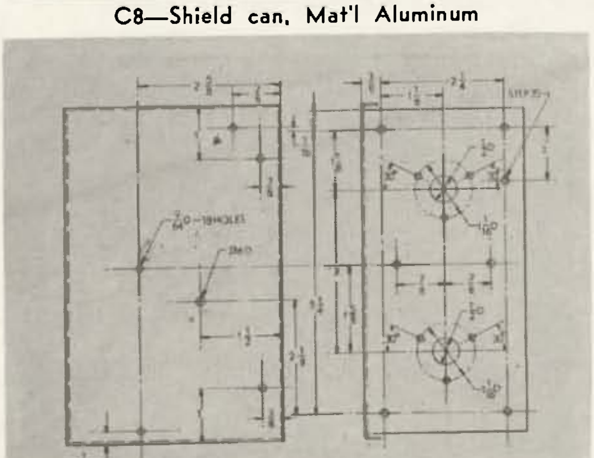
C8—Shield can, Mat'l Aluminum



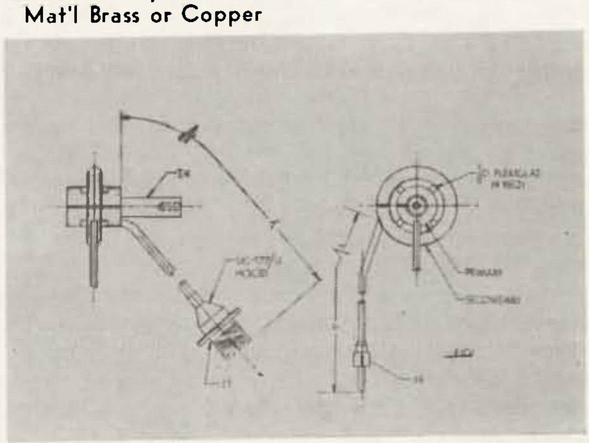
C13—Shield PS1A, Mat'l .005 Brass or Copper
C12 — Primary bobbin PS1, Mat'l Brass or Copper



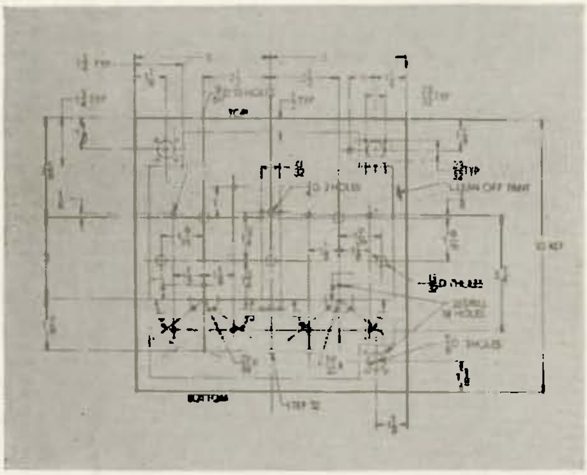
C14—Shield PS2, Mat'l copper



C9—3X4X6 LMB Shield can S5



C15—Transformer assembly



C16—Inside view of panel

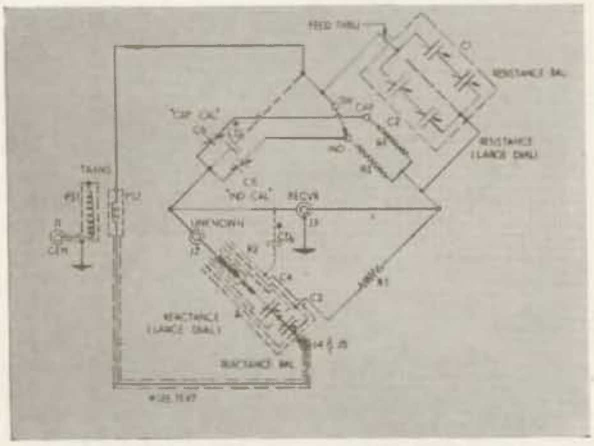


Fig. 1—HF. RF. Bridge Mark III Schematic

point A (see Fig. C12) and wind in the direction shown by the arrow.

13. The last turn will end at the shielding attached in step 11. Feed the free end of the wire into the shielding, draw the turns tight, and secure the winding with plastic tape.

14. Cut a piece of brass or copper shim stock as shown in Fig. C13 to a length which will wrap around the bobbin but will not allow the ends of the shim stock to touch each other.

15. Tin the shim stock along the edges.

16. Place the wound bobbin in a vise, wrap the shim stock around it, lining up the free ends of the shim with the slot cut in step 9, and solder the shim to the bobbin ends. Caution. *Do not overheat the winding; the plastic covering melts easily and a short is almost impossible to detect.*

17. Connect an SO-239 coax connector and UG-177/U hood to the shielded primary lead as shown in Fig. C15.

18. Wind one turn of ¼-inch diameter half-hard copper tubing around a 1-inch diameter form. Saw the tubing as shown by "phantom lines" in Fig. C14. Drill as shown in Fig. C14 and clean off all burrs.

19. Locate the 8-inch piece of shielding left over from step 10.

20. Using same technique as in step 11, solder one end of the shielding into the ⅛-inch hole. Clean off all solder splatter and burrs.

21. Solder one end of another length of No. 26 plastic-covered hookup wire to point A (see Fig. C14) and wind three turns inside the tubing in the direction shown.

22. Feed the free end of the hookup wire through the shielding. Bend the tubing into final shape as shown in Fig. C14. Pull up the three turns snugly, making sure that the plastic coating is undamaged.

23. Connect a male phono plug to the free end of the shielded wire as shown in Fig. C15. Length of the wire is critical.

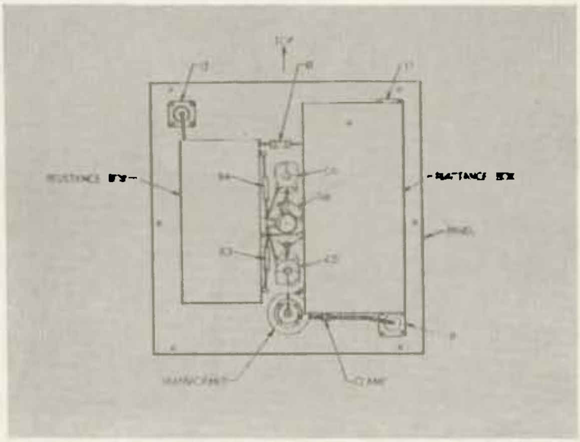


Fig. 2—Inside view

24. Using four pieces of ⅛-inch diameter plexiglas rod as spacers, assemble the primary and secondary shielded windings as shown in Fig. C15. Attach insulator I4 to the transformer by cementing it into the bobbin hole with Duco. Cement both windings to spacers with Duco and allow to dry overnight. This completes the transformer.

25. Remove top and bottom from the 8x10x10 utility box. Remove all paint from flanges; clean to bare metal to provide adequate rf shielding on reassembly.

26. Remove paint from inside of bottom plate for ½ inch in from each edge.

27. Remove paint from inside of top plate as shown in Fig. C16 by "phantom lines."

28. Drill the top plate as shown in Fig. C16.

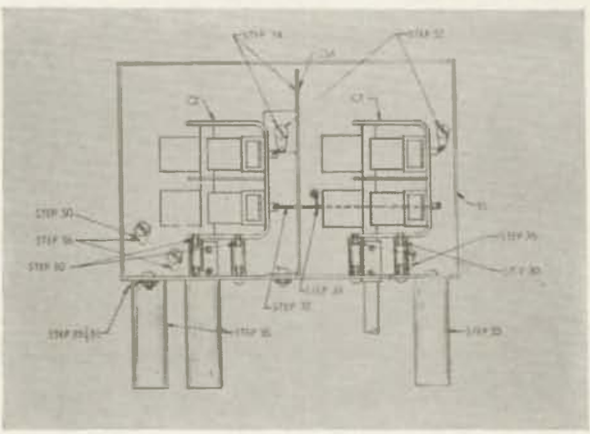
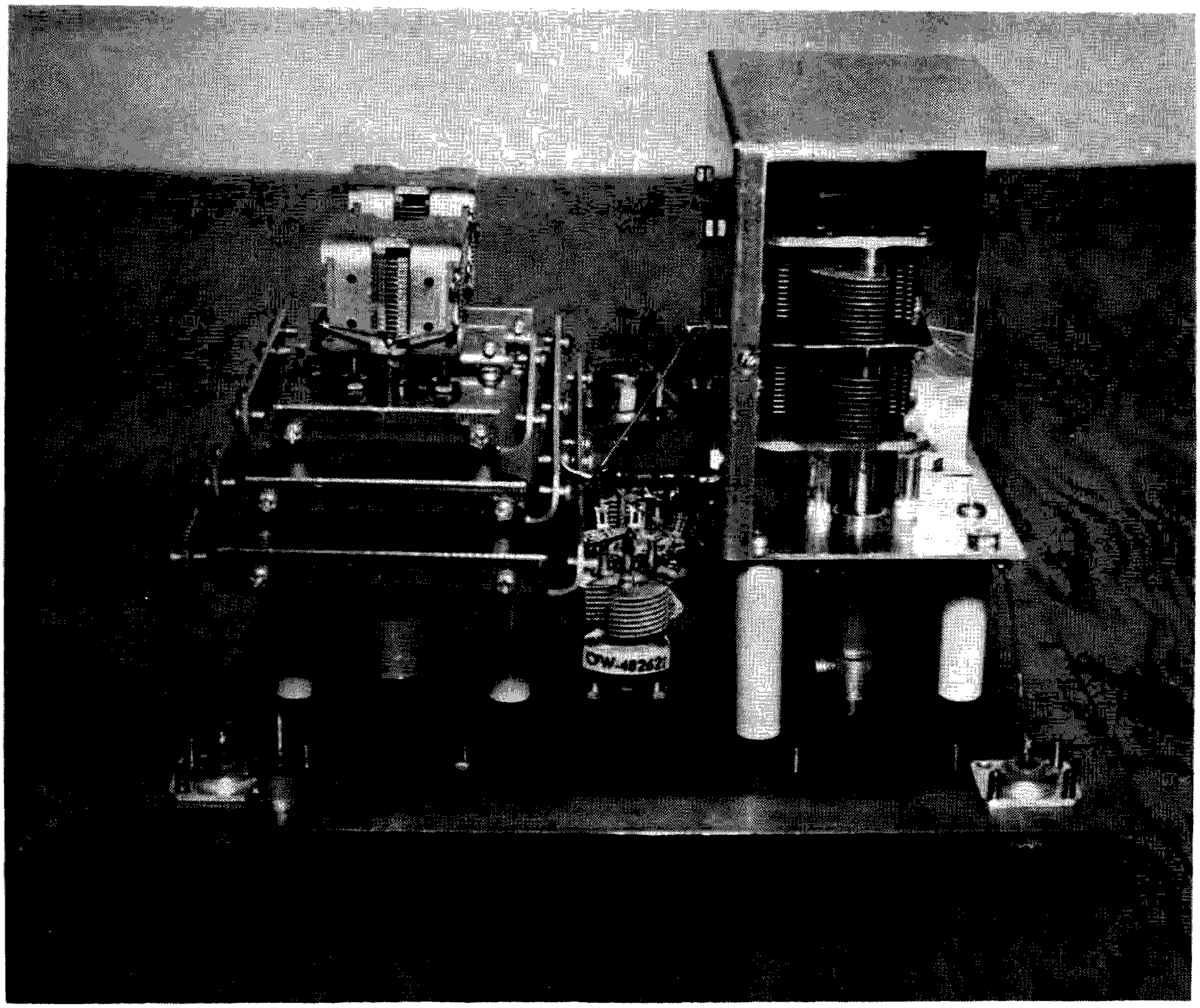


Fig. 3—Resistance box—Inboard view



Note that drawing shows INSIDE surface of plate.
29. Cut shafts of all four variable capacitors to ⅜-inch length. Remove all trimmer capacitors.
30. Tap the threeholes on the face of each capacitor, using a 6-32 tap. Take care not to damage the first stator plate; a bottom tap may be necessary. Attach three type I2 insulators to C1 and C2, using ¼-inch-long 6-32 set screws as shown in Fig. 3. This completes preliminary metalwork.

Actual Wiring

31. Attach C1 and C2 to shield box S5 using six ¼-inch-long 6-32 machine screws. Connect stator lugs of C1 to those of C2 with No. 18 tinned wire, as shown in Fig. 3.
32. Mount two soldering lugs as shown in Fig. 3 and connect remaining stator lugs to them, using No. 18 tinned wire.
33. Press the Erie CF-408 feed-thru into the 0.136-inch diameter hole in S5. Solder a short No. 18 tinned lead from the inside terminal of this insulator to the wire installed in step 31, as shown in Fig. 3.
34. Attach shield partition S5A, using three ¼-inch-long 6-32 machine screws. One of the screws installed in step 32 must be temporarily loosened and removed.
35. Attach four type I3 insulators to shield box S5 as shown in Figs. 3 and C9.
36. Attach three more soldering lugs to S5 as shown in Fig. 3, using ¼-inch-long 6-32 machine screws.
37. Attach four type I3 insulators to shield platform S1, using the 4¼-inch-spaced holes in S1 and 6-32 screws. Attach S1A to S1, using 6-32 screws from the inside of S1. Attach the female phono socket to S1 in the 7/16-inch diameter hole. Attach four type I1 insulators, using ¼-inch-long 6-32 screws. Do not tighten the screw in the hole marked "Hole A" in Fig. C1; this screw will hold a cable clamp later. See Fig. 4 for details of insulator placement.
38. Attach four type I1 insulators to shield platform S2, using the 2⅜-inch-spaced holes in S2 and ¼-inch-long 6-32 screws. Attach S2A to S2. Attach capacitor C3 with 1-¼-inch-long 6-32 screws, using two nuts on each screw as shown in Fig. 4. Mount a soldering lug under one nut as shown. Align the capacitor by adjustment of the mounting screws and nuts.
39. Solder a No. 18 tinned wire to the female phono socket and pass the wire through the corresponding hole in S2. Attach S2 to S1 with

¼-inch-long 6-32 screws going into the type I1 insulators attached to S1 in step 37.

40. Attach C4 to shield platform S3 using ⅝-inch-long 6-32 screws with dual nuts (same as in step 38). Attach S3A to S3.

41. Connect two of the stator lugs of C4 with No. 18 tinned wire as shown in Fig. 4. Slide shield assembly S4 into S3A. Center assembly S4 in S3A, using a piece of ¼-inch-long insulating tubing. Make certain that opposite ends of S4 and S3A are even as shown in Fig. 4, and cement tubing in place with Duco. Solder the shorted end of resistor R2 (which is in S4) to the wire connecting stator lugs of C4.

42. Attach shield platform S3 to S2, using ¼-inch-long 6-32 screws going into the type I1 insulators installed on S2 in step 38.

43. Place a ¼-inch-long 6-32 screw in the flange of S3 as shown in Fig. 4, with a soldering lug. Connect this lug to the stator lug of C3 with No. 18 tinned wire. Using ¼-inch-long 6-32 screws, mount a soldering lug in Hole B (see Fig. C1) of S1 and another in S2 as shown in Fig. C2. These lugs are mounted in a direction opposite to that of the platform flanges.

44. Attach the "unknown" ground lug to the panel next to the "unknown" coax connector hole, as shown in Fig. C16. Attach the "receiver" coax connector to the panel, from the inside. Attach the "IND-CAP" switch to the center of the panel, using an extra nut to position the switch as far as possible from the panel. Orient the switch as shown in Fig. 5. Place a soldering lug under each nut. Mount C5 and C6, using ⅜-inch spacers between the capacitor frames and the panel. Connect the

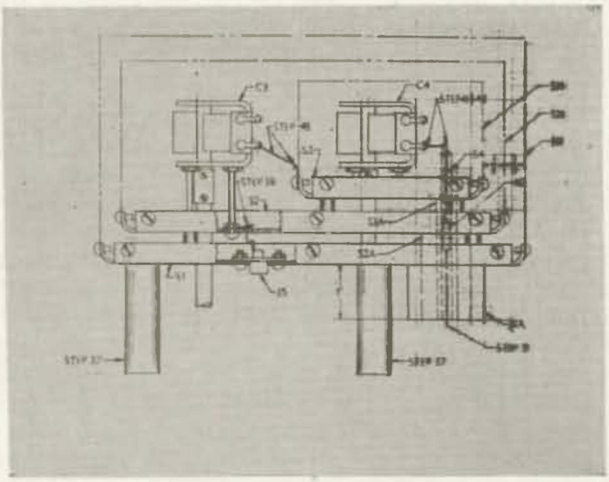


Fig. 4—Reactance Assembly—Inboard view

rotors of C5 and C6 to the lugs of the switch with No. 18 tinned wire as shown in Fig. 5.

45. Solder a 2½-inch length of No. 18 tinned wire to the "COMMON" terminal of the switch. Connect the stators of C5 and C6 to the remaining switch terminals, as well as resistors R3 and R4. Complete connections are shown in Fig. 5.

46. Attach the "unknown" coax connector to the panel, placing a soldering lug under one mounting screw. Connect the "unknown" ground lug to this soldering lug to provide a good bond.

47. Mount panel bearings for capacitors C2 and C4. Mount the special panel bearings furnished with the Johnson Vernier Dial assemblies in place. Attach the two large dials to dummy shafts and mount the dial indicator in the position you prefer. Remove the large dials and dummy shafts after placing the dial indicators.

48. Mount S5 at the left side of the panel (as shown in Fig. C16) and mount the assembly of S1, S2, and S3 at the right side. See Fig. 2.

49. Attach shaft couplers to the four capacitors. Cut the plexiglas shafts to length and mount them in place. Attach the large vernier dials. Set the dial of C2 so that it reads "0" at minimum capacity. Set the dial at C4 so that it reads "100" at maximum capacity. Mount the two Calrad dials on the panel, setting them so that they both read "0" at maximum capacity. Attach the knob to the "IND-CAP" switch.

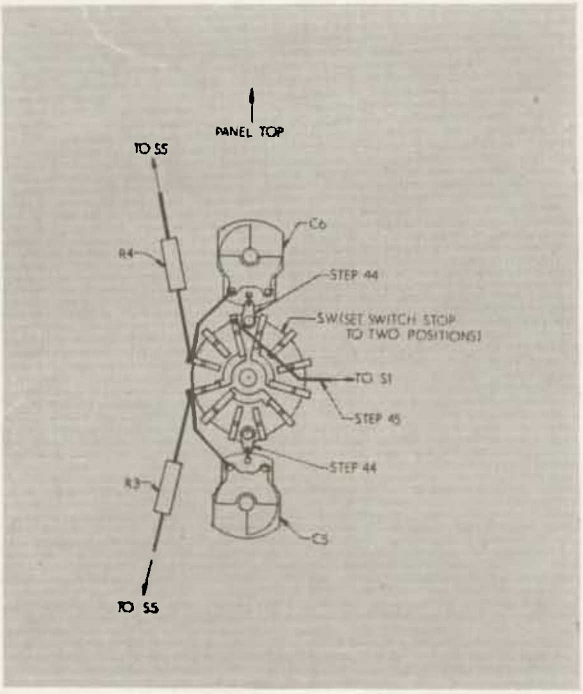


Fig. 5—Switch Assembly

50. Connect resistor R1 (270-ohm deposited-carbon) from the soldering lug on S2 to the lug in line on S5. Connect R3 (220 ohms) and R4 (100 ohms) to the soldering lugs on S5 which were installed in step 36. R3 will be the resistor nearest the bottom of the panel.

51. Connect a No. 18 tinned-wire lead from the "detector" coax connector to the lug on S5. Connect a No. 12 (note different wire size) lead from the "unknown" connector to the free end of R2. *Make sure that R2 is not shorted to any shield.*

52. Attach the transformer, completed in step 24, to the bottom of the panel as shown in Fig.

2. Attach the coax connector connected to the transformer to the panel in the "signal generator" hole. In the hole between the transformer and the connector, mount a cable clamp to hold the shielded primary lead. Secure the

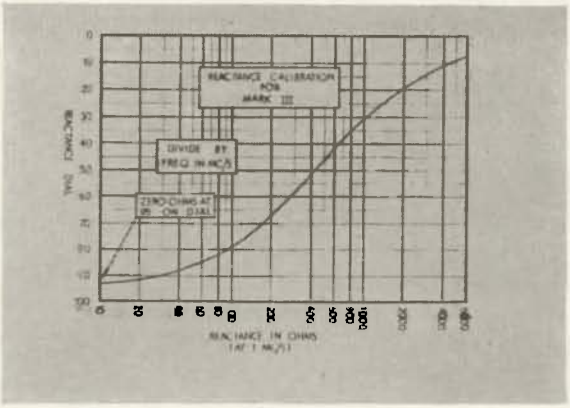


Fig. 7

shielded secondary lead with another clamp held by the loose screw installed in step 37.

53. Mount a soldering lug to S1B with a ¼-inch-long 6-32 screw, placing the lug in the direction of the box opening.

54. Place ¼-inch-long 6-32 screws in all remaining tapped holes in S1, S2, and S3. Starting with S3, place all shield boxes in place and secure screws. Connect a No. 18 tinned lead from the soldering lug installed in step 53 to the Erie feed-thru on S5. Set C5 and C6 to mid-capacity.

55. Attach four rubber feet to the bottom plate of the case and four more to the bottom side of the utility cabinet. Restore the front plate in place and secure with the sheet-metal screws provided. This completes construction of the bridge. After calibration, it will be ready for use.

Calibration and Use

Since the Mark III is a null-type instrument (adapted from the Schering bridge circuit) it can only be used with a signal generator and a detector. Both must be shielded; however, a Heath SG-8 will do nicely as the signal generator and any decent communications receiver will serve as the detector. For best results, it should be calibrated with the signal generator and receiver with which it will be used.

56. Connect the bridge to the signal generator and the receiver, using coax cable from the panel connectors to each.

57. Set both the signal generator and the receiver to 2 mc.

58. Short the "unknown" terminal and ground terminal using a banana plug in the connector or a coaxial short made by soldering the pin of a PL-259 connector to the shell through a copper disc.

59. Set the "IND-CAP" switch to "CAP."

60. Set the "Reactance" dial to 15.

61. Set the "Resistance" dial to 5.

62. Tune the signal generator, only, for maximum signal in the receiver.

63. Using the two small "balance" dials, reduce the signal in the receiver to the lowest level possible. This is the "null" or "balance" condition. The dials will interact, and multiple adjustment will be necessary. However, all receiver and signal generator adjustments must be left alone during this step.

64. Replace the short across the "unknown" connector with the 620-ohm deposited-carbon "test" resistor.

65. Using only the large "resistance" and "reactance" dials, null out the signal once more. Record the final reading of the "resistance" dial. If this reading is 95, you are extremely lucky and the first half of the calibration is complete. If not, proceed with step 66.

66. If the "resistance" dial reading is less than 95, increase the capacity of C6 slightly and repeat steps 60 through 65. If the reading is larger than 95, decrease the setting of C6 and repeat steps 60 through 65. Continue this process until the reading comes out at 95.

67. When capacitive calibration is complete, set the "IND-CAP" switch to "IND," and the "reactance" dial to 30.

68. Repeat steps 60 through 65; if the final reading of the "resistance" dial is other than 95, proceed with step 69.

69. If the reading is less than 95, increase the capacity of C5 slightly and repeat steps 60 through 65. If the reading is larger than 95, decrease the setting of C5 and repeat. Continue

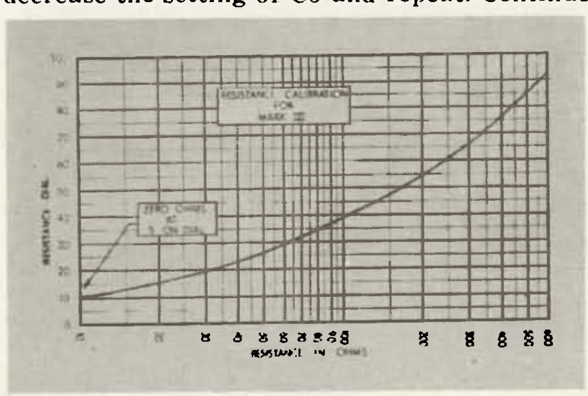


Fig. 6

until the reading is 95. This completes calibration, and the curves shown here can be used for readings.

Using the Mark III

To use the Mark III, set the instrument up as described in step 56 of the calibration procedure. Set the signal generator to the desired frequency and short out the "unknown" terminal of the bridge as described in step 58.

If you're measuring an inductive impedance, set the "IND-CAP" switch to "IND," the reactance dial to 95, and the resistance dial to 5. Null the signal with the small balance dials.

Now remove the short and connect the unknown. Rebalance the bridge using the large

dials, note the readings, and convert the readings to ohms by use of the calibration curves.

These initial values must be corrected. The reactance value is corrected by dividing the value read from the curve by the frequency (in mc) at which the reading was taken. The resistance value is corrected by obtaining the correction factor due to frequency from Fig. 8 and multiplying the reading by this factor.

If you're measuring a capacitive impedance, set the switch to "CAP." Then estimate the reactance of the unknown and set the large reactance dial to a value just larger. Set the resistance dial to 5 and short out the "unknown" connector. Null the signal with the short and again with the unknown, the same as for an inductive impedance.

Correct the resistance reading in the same manner as for an inductive impedance. However, the reactance reading is corrected differently: Subtract the value taken from the calibration curve from the value originally set on the reactance dial. Now divide this remainder by the frequency (in mc) at which the reading was taken. The result is the true value of capacitive reactance.

A few minutes' practice will make operation of the Mark III far more simple than the detailed directions would indicate; in practice, you can make a reading in less time than it

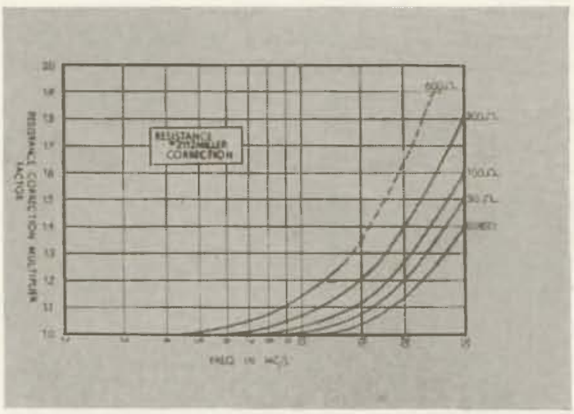


Fig. 8

takes to read these paragraphs.

Parts Substitutions and Design Changes

Since few hams are content to build a "Chinese copy" of someone else's design, a few words on the effect of changes are necessary.

Naturally, the Mark III doesn't represent the only possible—or even necessarily the best—way in which such a bridge can be built. Any part, or all, may be changed. However, any such change will invalidate the calibration curves, and is not recommended unless the builder has access to laboratory equipment.

Even then, before making any substitutions, these three design articles should be read and fully understood:

"A Radio-Frequency Bridge for Impedance

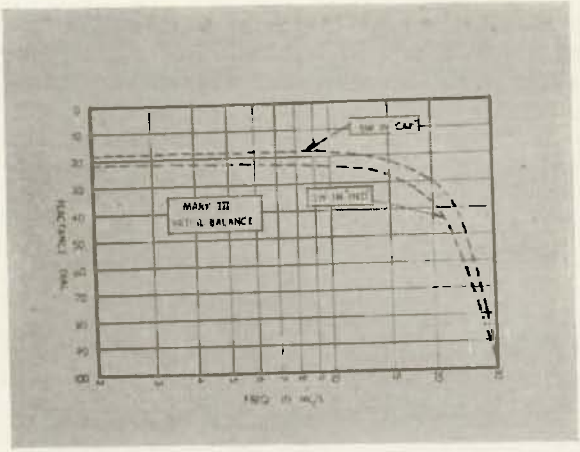


Fig. 9

Measurements From 4000 KC/S to 60 MC/S," D. B. Sinclair, Proceedings of the I.R.E., November, 1940, pages 497-502.

"A High Frequency Model of The Precision Condenser," D. B. Sinclair, General Radio Experimenter, October-November, 1938, pages 1-7.

"The Effect of Stray Capacitances to Ground in Substitution Measurements," M. Reed, Wireless Engineering, May, 1936, page 284 ff.

. . . K6CRT

Parts List

Quan.	Item	Description	Cat. No.
1 ea.	C1, C2	Miller, 10-365 mmf/sect.	2112
1 ea.	C3, C4	Miller, 10-365 mmf	2111
1 ea.	C5, C6	50 mmf air padder (good quality)	APC-50
1 ea.	J1, J2, J3	SO-239 Panel coax connector	
1	J4	Phono plug	
1	J5	Phono socket	
1	R1	Aerovox 1% 1/2W 270 ohm "Carbofilm"	Type-CP
1	R2	330 ohm 5% 1/2W Carbon Resistor	
1	R3	220 ohm 5% 1W Carbon Resistor	
1	R4	100 ohm 5% 1W Carbon Resistor	
1	Test	Aerovox 1% 1/2W 620 ohm "Carbofilm"	Type-CP
1	SW	Centralab 3p; 1 Sect; 2-3 Position (reset stop to two positions only)	2506
*2	Dials	E. F. Johnson Vernier (0-100 CW)	116-285-1
2	Brgs	E. F. Johnson Panel Bearings	115-255
4	Cplrs	Metal ¼ shaft couplers	
3	Rod	¼ inch diameter plastic rod x 12"	
1	Rod	⅛ inch diameter plastic rod x 6"	
2	Rod	⅝ inch diameter plastic rod x 12"	
2	Dials	"Calrad" 1-13/32 inch Vernier Dial	VD-36
1	BP	Binding Post (ground lug)	
1	Case	Bud carrying case 10"x10"x8"	CC-1100
1	Box	LMB box (plain) 3" x 4" x 6"	
1	Hood	UG 177/U coaxial cable hood	
1	Insul.	Erie feed-thru insulator	CF-408
1	Short	PL-259 coaxial male connector	
2	Clamps	Walsco clamp for ⅛ to 3/16 cable	7502-N

Of the above list the critical parts are:
C1, C2, C3, C4, J2, R1, Test resistor, Case, LMB box, UG 177/U, Erie feed-thru.

* This author hand engraved these dials per Figs. 6 and 7.

W2NSD from page 4)

yet reviewed in 73. We have reviews on hand now for the Knight R-55, Heath DX-60, VTVM, IO-10, Eico 723, J-Beams and LW-51. We're open for articles on everything else. If you have something new and the facilities to test it we'll pay $10 each for the info. Photographs not needed since the mfr will supply them gratis. To avoid duplication drop me a line and ask. We want not only your impressions of the gear, but some statistics such as stability of receivers, actual power output of rigs, etc. Try to put in everything anyone could possibly want to know.

Distributors

One of my first moves in getting 73 started was to find the name and address of all of the ham distributors that I could. This meant going through the back issues of magazines and club bulletins. This also meant that there were a lot that I didn't know about. Maybe you'll give 73 a little boost the next time you find a distributor with no copies on his counter. In addition to high pressuring him send me his name and address so I can send him information and maybe a sample copy. There are still hundreds of distributors that are not selling 73.

If you need any sales talk you can point out that he only pays for the copies he sells and that we pay the postage on all returns. You might mention that many distributors report that 73 is outselling all other ham magazines across the counter. Copies sell for 37¢ and wholesale at 24¢ in quantities of ten or more.

Sixer

One card came in exclaiming that with our July issue we had at long last produced a magazine without a mistake. Look again, buddy. Like look carefully at the S-Meter for the Sixer on page 28 and note the utter lack of parts values on the transistor (a CK722 or equivalent), the 1000 ohm pot, the 3 volt battery, and the 0-1 ma meter. Guess one of our proofreaders missed the omission when he was checking the schematic. Sure wish we had a proofreader.

June Votes

As I surmised from the early voting, Bill Ashby K2TKN came in first with his Abe Lincoln two meter antenna. Hi-Par heard about the antenna just before we printed the article and decided to have a go at making the contraptions. I haven't heard from anyone using it yet, but I suspect we'll be seeing a lot of those around before long. They sure are just what we've all been looking for in a mobile

(Turn to page 69)

Propagation

Part III

David A. Brown K2IGY

PART I of this series discussed the Sunspot Cycle and gave predictions for the remainder of the cycle. In Part II we reviewed the different variations, diurnal, seasonal and cyclical that MUF's for a given path are subject to, along with a Special Propagation Chart for the coming Winter season, 1961. For the last part of the series, Part III, we are going to see what the radiation angles are that are involved for DX propagation and what kind of antenna heights are needed for effective DXing.

There are several modes that can be used and that occur for propagation over a given path. The simplest mode for purpose of our discussion, would be where the signals are propagated using the F-layer in a series of geometrical hops (from Earth to the F-layer back to Earth again being a Hop), the number of hops depending upon the path length, the height of the F-layer and the angle of departure of the radiated energy. In the Wintertime the average F-layer height is about 320 Km. If the radiated energy leaves the antenna at a radiation angle of zero degrees, the maximum great-circle distance (remember the Earth's curvature) that can be covered by a single hop would be about 4,000 Km. Fig. I shows the relationship between radiation angle in degrees and great-circle distance in thousands of kilometers assuming a virtual height of the F-layer at 320 Km, for numerous geometrical hops. Each time a hop is made, part of the radiated energy is absorbed by the F-layer and some is also lost by the reflection from the ground. It is therefore, important to have radiation angles small enough to use the least number of hops as posssible and as is practical. Examination of Fig. I will show

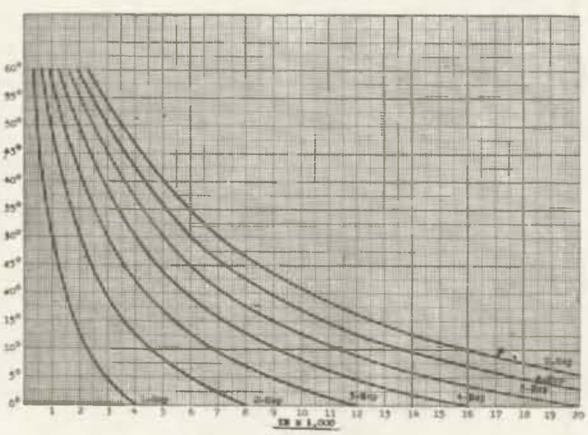


Fig. I

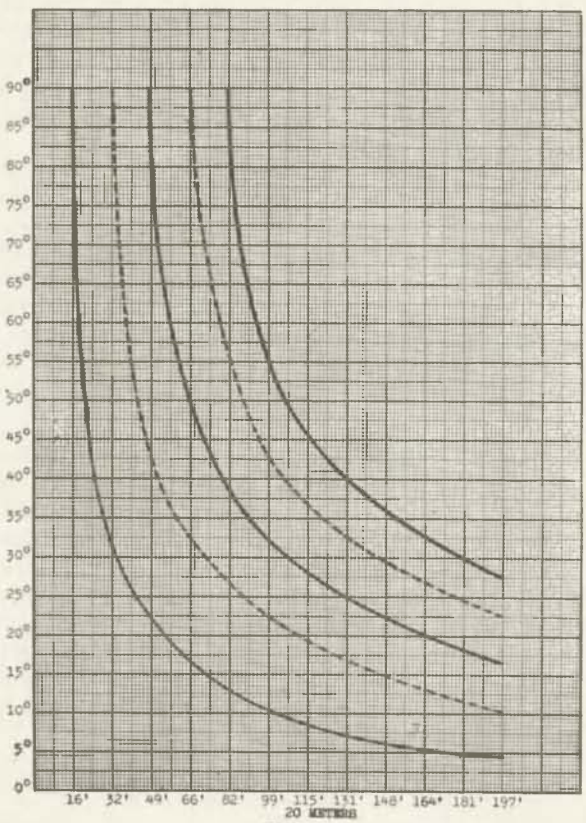


Fig. 2

you that radiation angles for DX propagation should be around 15° or less, to be practical. For example: the path New York to Alaska is 5,400 Km and from the chart the smallest number of hops is 2-Hops with a radiation angle of about 7°. If 3-Hops occur, the radiation angle will be about 15°. In general we find DX propagation having angles of departure and arrival from 2° to 5° to 10° and 12°

to 15°. Angles of from 2° to 5° as far as Hams are concerned, are impractical because of the great antenna heights involved. Let us see what the correlation between height and radiation angle is.

The radiation that leaves a transmitting antenna leaves at many angles of departure. The sky wave is the radiation which leaves the antenna at angles above the horizontal to the Earth and is reflected from the ionosphere. At the same time the sky wave leaves the antenna, there is energy radiated below the horizontal which strikes the ground and is reflected up towards the ionosphere. These "reflected waves" will combine with the sky wave before striking the ionosphere and the resulting combined field strength will depend upon: 1.) The height of the antenna above ground. 2.) The size of the antenna. 3.) The condition of the "ground." 4.) The way the antenna is oriented with respect to the Earth.

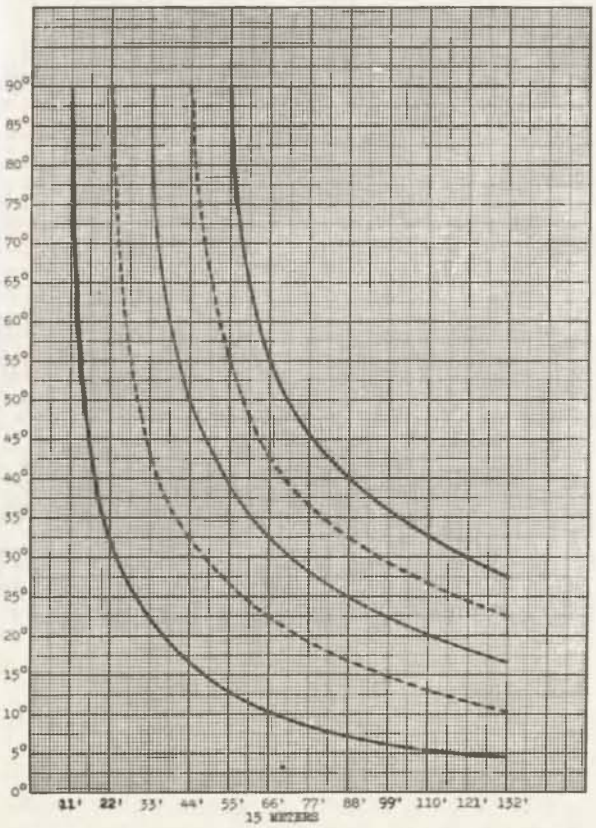


Fig. 3

The reflected wave must cover a greater disance before meeting the ionosphere than the sky-wave. When they meet in phase, the components add, and when they meet 180° out of phase the resulting field strength is the difference between the two. Fig. 2, Fig. 3 and Fig. 4 shows the height in feet above "ground" that antennas must be raised for different radiation angles to have the reflected wave in phase or 180° out of phase to the sky-wave, for the 10, 15 and 20 meter Ham Bands. These charts hold true for vertical antennas whose length is an even multiple of one-half wave

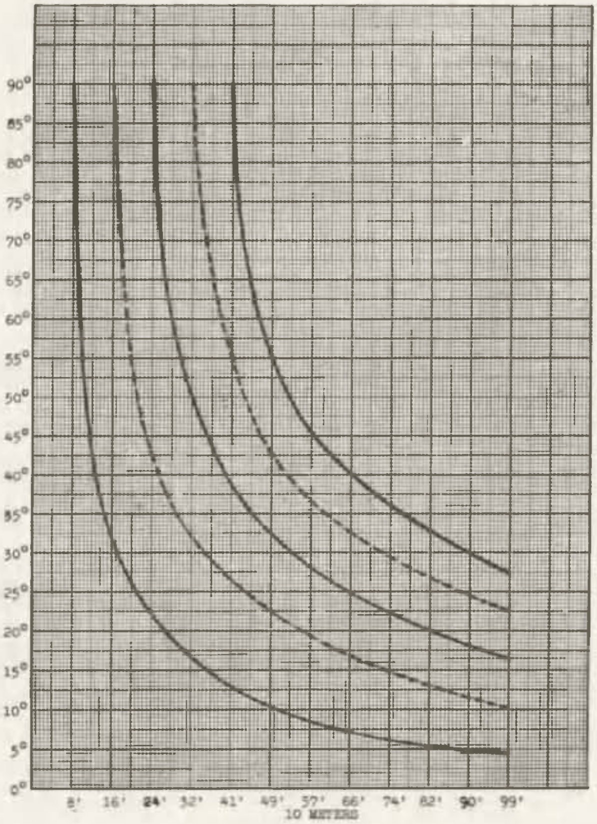


Fig. 4

length and for horizontal antennas. The solid lines being in phase and the dashed lines 180° out of phase. For vertical antennas that are odd multiples of one half wave length, the dashed lines are in phase and the solid lines 180° out of phase.

For DX propagation we are interested in low angles of arrival and departure (angles to the horizontal to the Earth). For radiation angles of 7° we find antenna heights of 123 feet for 20 meters, 82 feet for 15 meters and 62 feet for 10 meters. For angles of 15°, we find heights of 74 feet for 20 meters, 50 feet for 15 meters and 36 feet for 10 meters. These are the heights that our antennas must be placed for reinforcement of the sky-wave by the reflected waves above the "ground." By "ground" is meant the electrical ground which may be several feet below the Earth ground, the actual "ground" being found by raising or lowering your antenna for best results. As can be seen from the charts, sometimes the heights are unrealistically high for most of us to raise our antennas. For general all around tri-band operation, 65 feet seems to be about the minimum height for good DX operation, which results in radiation angles with in phase reflected waves for horizontal antennas of about 16° on 20 meters, 10° on 15 meters and 7½° on 10 meters.

For the greatest enjoyment in your DXing this coming Winter, I hope you all will consider getting the antenna up, as your "project" for this Summer.

Simple as ABC?

Jim Kyle K5JKX/6

ALPHABET soup can be confusing, as anyone who's tried to decipher the alphabureaucracy along the Potomac in the last 30 years knows. Does this same confusion extend to an appreciation of amplifier classification? If you're in the same boat as most electronics specialists, it does.

Everyone knows the difference between Class A, Class B, and Class C amplifiers. Of course you do. But to give your knowledge of the difference a real workout, try explaining it to another ham—or better yet, a hi-fi enthusiast who knows his amplifiers.

Chances are great that you'll emerge from the experience with slightly shaken faith in your own knowledge, and a bit of curiosity as to just what this business of amplifier classification means.

The reason for the confusion is simple; the special characteristics by which amplifiers can easily be classified can be described in several different sets of reference terms, and in addition distinctive usage in various fields of electronics has added some objectives which mean different things in different places.

The result is equally simple and predictable; if the person to whom you're talking learned a definition just slightly different from the one you learned, he hears you but he doesn't fully comprehend your meaning. The result can range from ordinary comic confusion to violent arguments, and possible monetary loss if misunderstood design recommendations are followed.

And if you don't think the probelm can be serious, try discussing a Class B linear amplifier with a hi-fi bug. He'll tell you, quite seriously—and honestly, in his own frame of reference—that such an animal can't possibly exist. It's a contradictory term, by definition!

Let's take a look at the basic distinguishing characteristic, first. An amplifier's plate current can flow either during the entire signal cycle, for just half the cycle, or for less than half the cycle. In the first instance only, it can flow without change or it can vary with signal voltage. In addition, grid current can flow or it can be absent.

This set of six conditions is the basis of alphabetical amplifier classification. Let's see how the definitions are applied in practice:

By traditional teaching, Class A is defined as that condition in which plate current flows unchanged throughout the cycle. Class B denotes the half-cycle condition, and Class C describes the less-than-half-cycle situation. Subscript numbers are used to describe grid current; 1 means it's absent, 2 means it flows.

While this grouping describes six possible cases, in theory at least, in practice it omits some of the essential combinations and describes some that don't exist. For instance, a Class C1 amplifier is self-contradictory; to operate Class C, grid current must flow.

The omissions are made up for by introducing another classification—AB—to cover the case in which plate current flows throughout the cycle but varies with signal voltage. In practice, the grid-current subscripts are usually applied only to the Class AB instance, and are always included there.

The past three paragraphs have described the traditional grouping. If it were the only set of definitions, the situation wouldn't be so difficult. Let's look at another popular set, taught widely:

In this group of definitions, Class A indicates that plate current flows for 360 degrees of the signal cycle. Class AB indicates a conduction angle between 181 and 359 degrees. Class B indicates a conduction angle of exactly 180 degrees. Class C indicates a conduction angle of 179 degrees or less. Presence or absence of grid current is indicated by subscripts as before.

This may sound as if it's the same set of definitions restated in different terms. That's what it was originally intended to be, but a few significant differences have crept in along the way, with the result that frequent arguments arise about just what constitutes, for example, Class B operation? Or, where's the dividing line between A and AB?

If you look closely you can see, for instance, that the condition termed Class AB1 in the first group has become pure class A in the second, which is based entirely upon conduction angle with no regard for the plate current readings.

The confusion engendered by these not-quite-consistent sets of definitions apparently prompted the author of at least one electronics textbook to eliminate all mention of amplifier classification with the single exception of Class faction with his own equipment and methods A, which was subtitled "Linear Amplifiers" on the assumption that Class A circuits act in a linear manner at all times. Other amplifier circuits were lumped together under the term "Operation in the Switching Mode."

While elimination of the time-honored letter code made the explanations of circuit action much easier to follow than the usual text material, it's no help to the reader who must then go into the real world and communicate with others about his equipment. And this leads to another problem—

In circuit theory, quite properly, only the

lass A circuit operated in such a manner ıat the output is a true reproduction of the ıput, free from distortion of any sort, can onestly be called "linear." This strict defini- ion is also accepted by the audio designers nd enthusiasts, to whom linearity means urity of original signal.

On the other hand, in broadcasting, televi- ion, and SSB ham radio, a "linear" amplifier requently means a Class B circuit operated in uch a manner that, although the exact signal pplied to the input is highly distorted at the utput, the modulation envelope of the original ignal is amplified in a distortion-free manner.

And if mention of this point and hints of imilar contradictions in usage between other ields seems ridiculous, bear in mind that hould you ever want to get a job in elec- ronics and be obliged to take an examination, hat examination may have been prepared by ın audio expert who wasn't familiar with ham ingo—and will almost certainly be graded by ı personnel man who only follows the answer heet and won't be impressed by explanations of semantic differences.

It's customary to draw conclusions as the end of an article is approached, but this hap- pens to be a situation in which the only con- clusion to be drawn is that we should all know all the definitions, the points of difference, and the cases in which they apply. A chart show- ing the points of agreement and differences is included (Fig. 1). If you don't want to memorize it, at least clip it out to keep handy the next time you have occasion to discuss am- plifiers. Who knows—the embarassment you eliminate may be your own! . . . K5JKX/6

Stencil Correction Tape Simplifies Drawing Changes

Changes and modifications to complex cir- cuit diagrams are often difficult to make with- out creating an unsightly and confusing mess. The problem is compounded if the finished product must be reproduced.

Changes, particularly block out of long lines, are easily made with a pressure sensitive gummed tape designed for making corrections on fluid duplicator stencils. One very satis- factory product is made by the Avery Label Company of Monrovia, California and is avail- able through office supply dealers. The white bond paper tape is 1/6" wide and is mounted on a "peel-off" backing. Simply trim to the desired length, peel off the backing and apply over the symbol or line you wish to delete.

Once applied, the tape is there for the life of the drawing, so be cautious. The tape takes typing, ink or pencil and its use will result in professional appearing drawing changes.

. . . Pafenberg

The Romance of Dixie Dan

Down below the Mason-Dixon line
In the mountains covered by fir and pine
Lived a rugged cuss named Dixie Dan
An all fired good amateur radio fan.

Dan lived alone with his trusty rig
And to him no woman was worth a fig
With his rig on the air, he'd rather yak
Than have a gal in his mountain shack.

One day Dan was tuning the band
When in roared a signal that sounded grand
With the lilting voice of a yl ham
And as Dan listened, his old head swam.

She was calling CQ, and when she signed
His transmit switch was hard to find
With a shaking voice, he gave her a call
And when she came back, he thought he'd bawl.

To the W4, this is Alaska Kate
A KL7 in the 49th state
Your signals sound good and so do you
So let's go ahead and have a rag chew.

The Q-so went on, lasted almost a day
And Dan's rugged heart melted away
The love bug had bitten, Dixie Dan fell
He vowed he'd make Alaska Kate his gal.

Dan went mobile the very next day
And started North up Alaska way
He kept a sked each day at dawn
And Alaska Kate's voice kept luring him on.

On the Alcan Highway, Dan nearly froze
In banks of snow as high as his nose
But the lilting tones of Alaska Kate
Kept him warm and feeling great.

He fought off wolves with his ten meter whip
And strangled bears with his mighty grip
Always forward he traveled along
With Alaska Kate's voice his guiding song.

Tired and weary, Dan made his way
To Alaska Kate's shack one cold day
He opened the door and stepped inside
And what he saw made him wish he'd died.

There sat Kate in front of her rig
And around her were kids, little and big
She hoisted her bulk out of the chair
And greeted her man like a damsel fair.
"My hero," she cried, in her lilting voice
Your handsome face makes my heart rejoice
You're the answer to a widow's prayer
With my nineteen kids, we'll make quite a pair.

With terrified scream, Dan turned and ran
To escape the fate of becoming Kate's man
She called and pleaded, as did every kid
But he ran like a man who's flipped his lid.

Dan quickly returned to his southern home
Determined for sure he'd never more roam
And there with his rig in his mountain shack
He's back on the air, and still likes to yak.

He never comes back to a yl ham
When he hears one call, he makes likes a clam
He's never forgotten Alaska Kate
And how he barely escaped a most horrible fate.

Ken Johnson, W6NKE

Letter

Dear Wayne:

In your July editorial you invited comment on that smashing idea of having the F.C.C. sell funny calls (special licenses was the elegant term) to hams. My comment is—it makes me sick.

Briefly, let's face the facts. Education is tightening up. A lot of us middle-aged guys are going to have difficulty this autumn getting into the college of our choice. Personally I'm going to have trouble with Mills and Vassar. Part of the trouble is my wife's fault. Her clothes won't fit me. Or suit me, if you like it punwise. However I should have foreseen the problem for there is quite a difference in our ages. I married her as a child. I was fourteen and she was thirty seven. But I couldn't resist her; she had a kilowatt and a two-letter call, while I was shy, with a 59 tri-tet and thick ankles. The shyness wore away but the thick ankles left me with a bum fist. As it turned out this was part of my charm—if anything so small could have parts. True, I was always a lid, but I tried to be a good one. One hand key for dots and another one for dashes. In time, as a result of much two-fisted practice, I was unique among beginners for I could copy with ease and knew that sending was my weakess. Of course there were the usual problems that plague a boy's life. One of them was the delusion common to the young and/or lazy ham that the maze of coils and spirals in a bedspring could be made to radiate energy as well as absorb it. Experiments along this line revealed the interesting behavior of people when they are awakened by blue arcs under their bed and the unmistakeable fragrance of scorched hair. But that was years ago, and if my ideas weren't fruitful one should remember that I was only a lad of twenty eight and at least my head was pointed in the right direction.

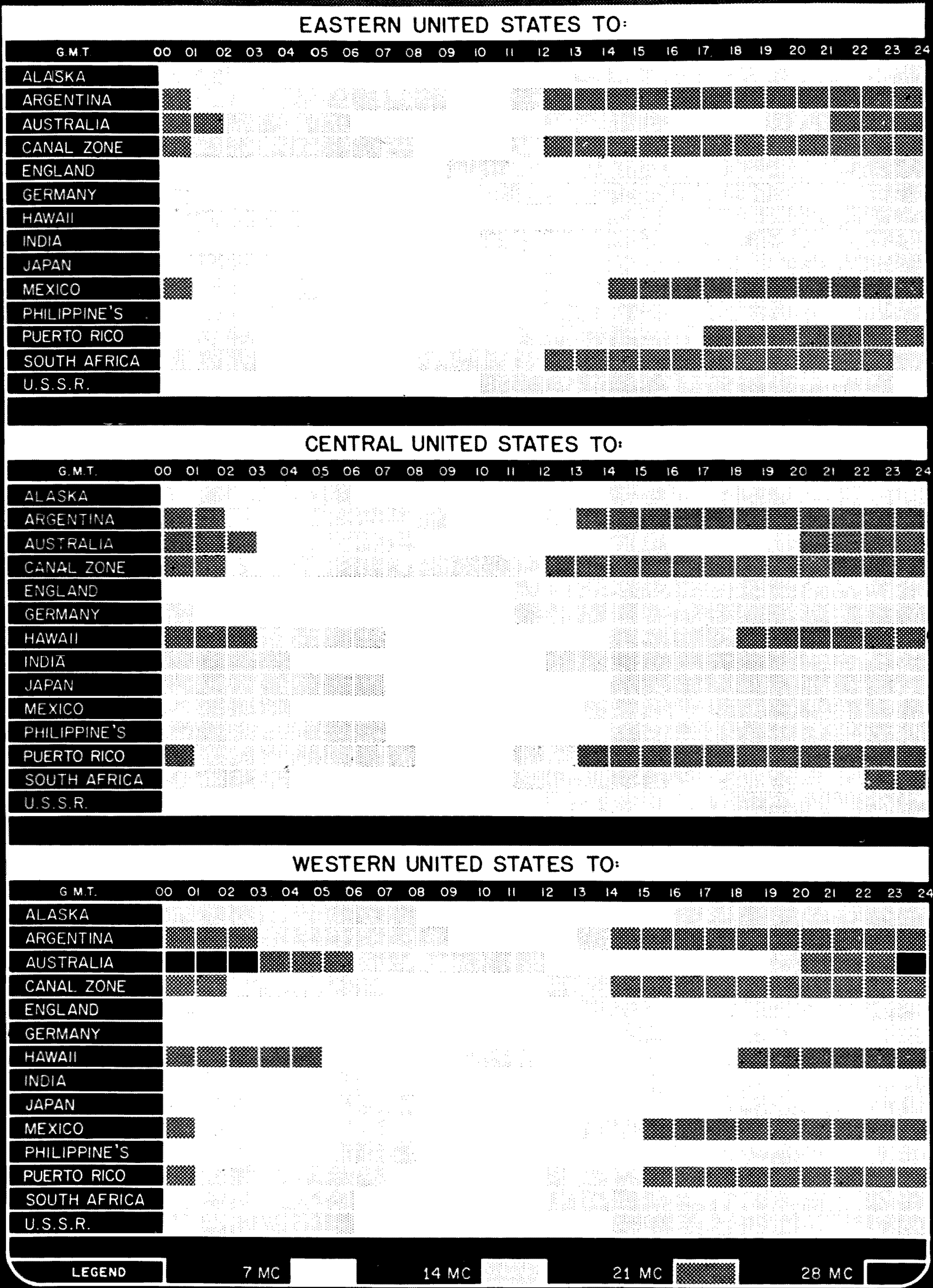
Time passed, as it does when one is typing, and I exercised my talents in a variety of fields, inventing the flesh-colored pistol for plainclothesmen, a series of self-solving problems for detecting schizoid syndrome in computers, the famous SSM (Schokoladespieronierenmaschine) device for exposing off-center fruit in chocolate-covered cherries, the concept of mounting tube sockets on hinges to provide storage space for stamps and marbles. Some ideas were simply too brilliant to find acceptance, such as rotating the stator plates rather than the rotor to do away with the need for a pigtail or spring contact. You and I know that superlative genius meets with skepticism and jealousy. In a vengeful mood one day I reflected on this and decided to forego creativeness, to concentrate more on exploiting what we already possessed. Working late one night on an exhaustive test of a typical toggle switch to find what hidden potential in this device my wit would illuminate it suddenly came to me that it could be operated in a horizontal position! But I had forgotten something, in the horizontal my rhinestone cut painfully into my navel. I gave up research.

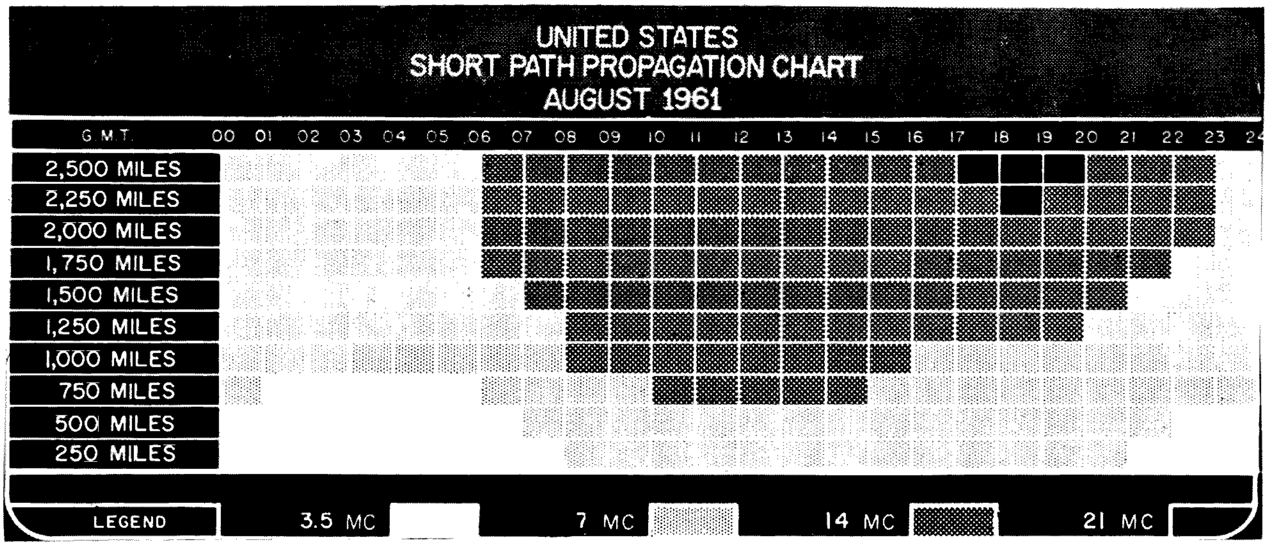
My subsequent withdrawal was a blessing in disguise, to coin a phrase. In disguise opinion—that's the phrase. Anyway, sir, I found an ideal outlet for today's neurotic—writing to the editor. Any editor. They're pretty much the same, aren't they? Nice guys, but . . . well, who else uses gold color typewriter ribbon? Or hangs a homey embroidered sampler over the desk: "He-men Don't Cry; They Keep Their Mascara Dry." Of course it's true that you're the only editor I've written to but obviously you are a conformist and represent the pattern. For proof note the characteristic device employed with subscriptions. A two-year stretch of 73 costs five bucks, but one for me and one for my mother costs six. Surely the extra reader brought in on a gift subscription is worth the trouble of the extra stencil. Why penalize the good-hearted? Another minority group abused.

Oh yes, speaking of minority groups, that's what I was getting around to: I'd like to vote a few times

(Continued on page 69)

PROPAGATION CHART





Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

Advanced Forecast: August 1961

Good 1-11, 13-14, 16-28

Fair 12, 15, 29

Bad 30-31

The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earths curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HBF's next to the 1250 mile listings will give the HBF to use and the time periods given will be the same

(Turn to page 69)

Jim Kyle K5JKX/6
1851 Stanford Ave.
Santa Susana, Calif.

Four Kinds of Ham

THESE days, it seems to be fashionable to sling mud at one's neighbors. Both on the air and in print, we see Novices denouncing Generals, Generals denouncing Novices, Technicians denouncing both, rag-chewers loosing blasts at contest enthusiasts, DX-ers complaining about foreign BC stations, etc., etc., etc.

In line with 73's Number One policy—We Are Not Mad At Anybody—and in the interests of unity within our ranks, let's take a few random slices through the ham world and see just how bad the situation is (or isn't, as the case may be).

One of the first things to examine is this question: Just what is a ham, anyhow?

International law and Government regulations give us a pat answer to that one: An amateur radio operator is a person who is interested in radio and is licensed to operate an amateur radio station because of his love of the art, without hope of any pecuniary reward.

There's just one thing wrong with that definition, for our purposes. It's too broad. After all, it fits each and every one of the "offenders" mentioned earlier (except the illegally operating BC stations, at whom we *are* mad). We are going to have to find some definitions which are more suitable to the case at hand.

We can try the FCC classifications: Extra Class, Advanced, General, Conditional, Technician, and Novice. However, while these may tell quite a bit about the skill, knowledge, and experience of their holders they won't tell us a thing about the essential characteristics of the typical ham's personality—if there is such a person as "the typical ham."

So at this point it appears that, in order to bring some order and unity into the situation, we're going to have to introduce some classifications of our own. The labels themselves aren't new, but some of the interpretation of the labels may be.

Without too much difficulty, we can divide every trace of amateur radio activity into one of these four categories:

* Public Service
* Rag Chewing
* Experimentation
* Contest Activity

At this point, someone is undoubtedly howling. "You forgot the DX men!" They weren't forgotten. After all, what is the DX chase if it's not a contest—the biggest and most liberal contest of all ham radio history, with no time limit or entry restrictions? With that point out of the way, let's examine these categories in some detail and see what we can deduce about them.

Public Service heads the list because it's by far the most spectacular part of hamming. If you doubt this, check the clipping files maintained at League headquarters— or ask any newsman who's acquainted with our hobby. The part of ham radio which most frequently makes news is that which provides communication to ice-, snow-, or flood-bound areas; which aids in dramatic rescues; and which is connected with disasters. And all this can be listed under no other heading than Public Service.

In addition, this classification most obviously serves the Public Interest, Convenience, and Necessity—the FCC's PICON rule for justifying any radio service. So it appears that we must all gree that Public Service is essential to the survival of ham radio in any form.

Included in Public Service activities, by the way, in addition to the glamorous items listed earlier, are the long hours spent handling traffic by hundreds of hams who inhabit the lower end of 80. They're quiet, for the most part, but they're there and we're all better off for their existence.

How about the Rag Chewer? If we were to conduct a random-sampling survey of all bands for several weeks, we would undoubtedly find that something like 90 percent of all on-the-air activity falls into this category. No definition is really necessary—if we're not rag-chewers ourselves, we all know several.

There's no question that the rag-chewer has fun for himself—possibly more than any other kind of ham—but how does he benefit the hobby?

It may sound strange at first hearing, but we believe that he also serves the Public Interest, and serves it well. Here's the reasoning:

While a few rag-chewers only talk to fellow hams in the same area, most have a regular circle of chatters scattered across the nation. More than a few extend their rag-chewing to an international level.

One of the major characteristics of the rag-chewer is that he not only talks, he listens. Some observers have termed this branch of our hobby "the last refuge of the fine art of conversation." One of the distinguishing aspects which differentiate "conversation" from plain "talk" is that both participants learn from a conversation.

What is this leading up to? Simply that most rag-chewers are better-informed about opinion and activities around the nation and the world than are their less-voluble brethren. An informed citizen, to paraphrase Jefferson, is a useful citizen. For this reason, and no other, we believe that the rag-chewer is a top-level servant of the Public Interest.

Then there's the Experimenter. He's the chap who likes to try out new ideas. You might call him the "Good Amateur" of John Campbell's article in our initial issue—he doesn't know that something can't be done, so he goes ahead and does it. An excellent pair of examples are W6NLZ, John Chambers, and KH6UK, Tommy Thomas. Their exploits in the VHF and UHF region between California and Hawaii are legendary. For a list of additional "Experimenters," see the table of contents on any issue of this magazine—or check the subscription list.

With the exception of the few who come up with a fantastic advance in the state-of-the-art (such as Chambers and Thomas, or more recently the Moonbounce experiments sparkplugged by Sam Harris) you don't hear very much from or about the experimenter. His main interest is in the equipment itself, and frequently the only time you'll find him on the air is when he's testing his latest gadget. The rest of the time, he's lost in the workshop, soldering iron in hand . . .

Like the Public Service man, the Experimenter's place in our firmament is almost universally acknowledged. While he doesn't quite fit into the "Convenience" part of the FCC

(Turn page)

(Four kinds from page 51)
formula, there's no question that he serves the Public Interest and Necessity—without him, much of the territory above 200 meters would never have been explored.

This leaves until last the Contest enthusiast, including DX-ers. No slight is intended by this positioning. The fact of the matter is that whether you like him or hate him, he's one of the most necessary of all hams.

Here's the reasoning behind that statement: The Public Servant is a quiet, behind-the-scenes type in most cases. He uses his station as a tool to help people; many stations manned by this variety of operators have undergone little change in the last 10 years, because the equipment installed then is still doing its job adequately. The Rag Chewer lives in front of the scenic backdrop, to continue the metaphor, but his concern for equipment is at about the same level. The experimenter, for the most part, builds his own gear. But the Contest man? What about him?

By our definition, he's primarily interested in winning a contest; this contest may be simply to gather more DX QSLs than anyone else in the world, or it may be an annual event with organized rules and time limits. In either case, he's not primarily interested in equipment—only results.

But in the big leagues of Contest Activity, results can be expressed as a function of three variables: operator skill, equipment excellence, and luck. At the top level, operator skill is about equally distributed. Luck, also, is equally generous (or foul, as the case may be) to all. But equipment excellence is a variable which can be controlled.

Since the Contest man's prime interest is in results, and the equipment itself is only a tool, the chances are great that he will purchase the equipment rather than building his own.

This trend has been noticed by many, and is evident in some of the published complaints that ham radio is in danger of becoming "a millionaire's hobby." However, the trend isn't necessarily a danger.

Without the Contest Man and his avid desire to have the best of everything with which to pursue his own star, where would the industry which supplies us all be? Odds are that the answer to that question is, "Nowhere."

All the top ham manufacturers have large military contracts. With almost all of them, ham radio is now just a sideline. The moment it stops being a lucrative market, they'll be forced by economic necessity to reduce their lines. For that reason, if no other, the Contest Man with his relatively-open pocketbook is a necessity to the continued existence of our hobby. And this is not the only justification for the Contest Activity.

No less an authority than J. P. Costas, writing in the Proceedings of the I. R. E. several months ago, compared average amateur radio activity with the situation facing any military communications outfit during combat—interference, difficulty in confirmation of messages, and all the rest. Over the years, many others have lauded ham radio as one of the best training grounds for skilled radio operators—and this part of the field falls into the "Contest Activity" domain.

So in one point of view, at least, all four of these four kinds of ham are essential to the hobby. A couple more points to be considered are these:

Any individual ham is not limited to just one of these four types. You, yourself, may be one part Contest Man, one part Public Service, three parts Experimenter, and the rest Rag Chewer—or any other combination of part or all of the types. The major point intended by the classification was that *all* ham activity can be described within the limits of these four categories.

The second point is this: While you may not like one or more of these types of activity, it's really sort of pointless to knock it either. Granted, it's disgusting to find a Rag-Chewer parked on your only crystal frequency when the long-hop skip is in and you hear an AC4 calling. It's also more than irritating, while chewing the rag, to be "invited off" the frequency by a too-ardent DX-er. And Experimenters have been known to clobber an entire band when something went wrong during an on-the-air test . . .

However, as we've tried to show, all four are necessary to ham radio. Doing away with any one class would irreparably harm the remaining three. And restrictive legislation or regulations which limit their activities will do no good for anyone.

Let's face facts, fellows. While ham radio *can* be divided into four parts, any one of the four requires the other three for support. In plainer words, first attributed to Ben Franklin (an early Experimenter without benefits of ticket), "We must all hang together or all hang separately." How about it? Can we see the other fellow's point of view for a few minutes at least? OK? Now, then, about those illegal BC stations in the 40-meter band. . . .

73

Lifer Number I

Lamon Whiddon K4MYH, the discouragingly healthy-looking chap above, backed the editor up against a wall during the Miami Convention and forced him to reveal the secret rate for lifetime subscriptions to 73. So, the news is out. The rate is $30 for life. This rate has been set up particularly for hams with sons who are QCWA members, fellows with heart conditions who like to climb towers, heavy smokers, etc. We will accept marginal cases of chaps with a history of cancer in the family or who are seriously overweight. We are not particularly anxious to sign up any more such robust specimens as Lifer Number 1.

Letter

Editor of 73 Magazine:

Say, where in the Hell do you get that QRM! Do you know that broadcast and TV stations get their license for free?

They make thousands and thousands of dollars from their stations and in most cases have a monopoly at that.

Why the hell should hams have to pay for a license? It's about the only thing that is free any more. Let it stay that way.

As long as the USA pours money down rat holes all over the world in the name of defense and relief (trying to buy friends) why shouldn't they give the hams a license. It's the hams that furnish the radio men come a war.

Oh yes, while we are about it—Our old 11 meter band is now CB. It's free too and they don't furnish any radio men for the country, either.

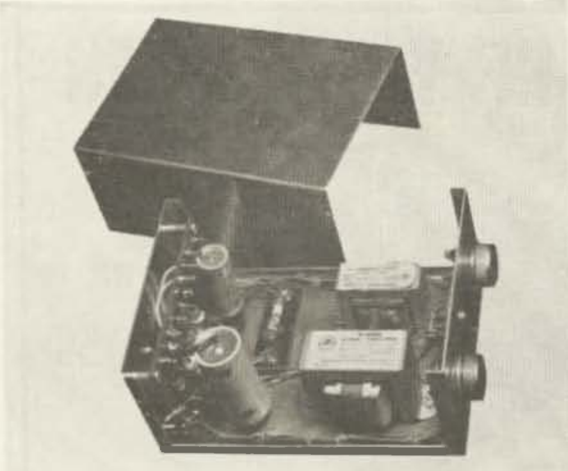
Also, all other services get their license free.

Again, why should the ham pay?

I hear the boys in Canada do—you and any other hams who want to shell out can move up there.

Clyde Rubottom W9OKX

Too cold.



Austin C. Farrell W2BXE
27 Heath Road
Fishkill, New York

Mobile Power Converter

THE transistor power converter is the latest development in a long line of power supplies for mobile operation. The vibrator supply, long used, is often in need of a new vibrator. The dynamotor is a bulky supply and expensive, unless bought surplus. The transistor converter eliminates moving parts, is more efficient, and much smaller than any previous type supply. One thing has made it lack full acceptance by the amateur—that is cost. This supply is an answer to that problem by its use of easy to obtain filament transformers.

The circuit (Fig. 1) is not the design of the author but has been used by many hams in the Poughkeepsie, N. Y. area. Two 6.3 volt filament transformers are used; one as a power transformer and one as the feedback transformer. The basic circuit is a multivibrator. One transistor is cut off while the other is conducting. The collector current of the conducting transistor passes through half of the 6.3 volt winding of the transformer T-1 similar to the operation of the standard vibrator circuit. The primary of this transformer steps the voltage up to a large value. This induced voltage is rectified by the solid-state diode-bridge circuit and filtered by condenser C2.

The feedback transformer (T2) steps the high voltage ac down to a low level for drive to the bases of the transistors. Q-1 is driven to cut off when Q2 is driven to saturation and vice-versa. Resistors R1 and R2 sets the operating bias.

The transformers used are not ideal for the job as the normal operating frequency is about 400 cycles and the core material should be square loop material. However, the circuit as described is quite practical. It may be worth while to experiment with 400 cycle transformers if you have some available.

A 1.2 ampere filament transformer was used for the feedback transformer (T2) because it was readily available. Any size, smaller or larger will do. Nothing is gained using a larger one as little power is required. The step-up transformer (T1) is a 6.3 volt, 3 ampere filament transformer. A higher current transformer can be used, giving slightly higher voltage and more power. You are cautioned, however, to use good heat sinks on the transistors and check for excess temperature. There is little impedance in the low voltage windings to limit collector current to a safe value. Some experimenting was done with other transformers, but the 3 ampere

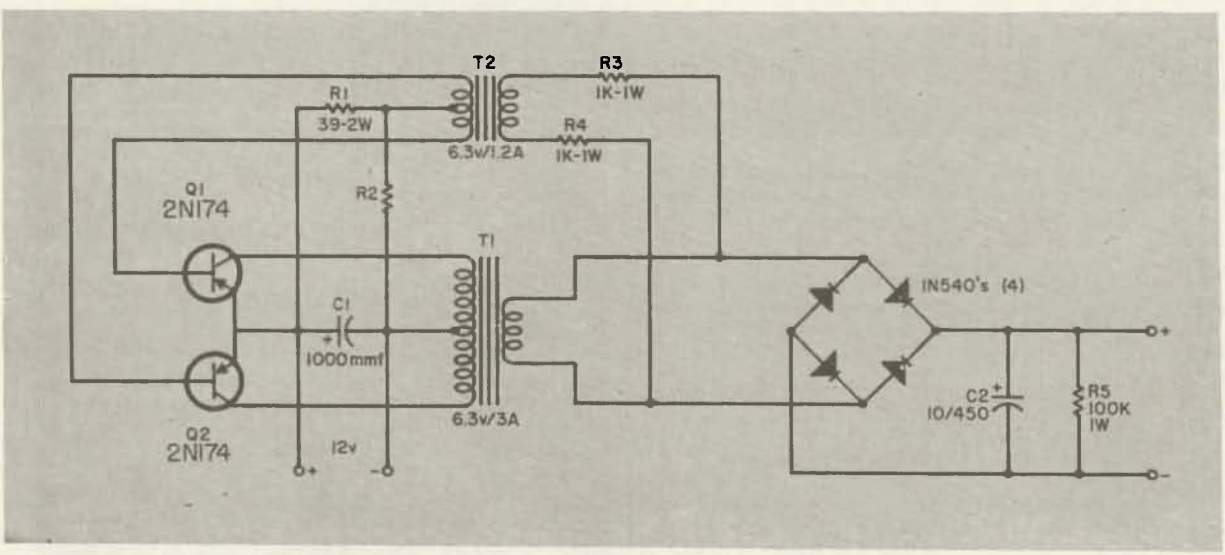


Fig. 1

transformer seemed to be a safer design. It will run warm in normal operation. A 5 volt filament transformer will give higher output voltage but current available will be less to keep within the power ratings.

The waveform of the high voltage ac and the waveform at the transistors (collector-to-collector) should be a square wave. There should be no spike on the leading edge of the square wave as this could cause breakdown of the transistor. The purpose of the large filter condenser across the 12 volt supply is to eliminate this spike and to filter out line noise.

Theoretically, the supply should not operate unless the feedback winding to the transistor bases are of the proper phase, but I found that it would work with the wrong phasing at much reduced output. Efficiency is much lower and collector current is high. Also the waveform is closer to a sine wave than a square wave. This condition causes the transistors to remain in the linear portion of their curves for a longer period during each cycle, causing them to overheat. Do not allow this condition to exist. To reverse the phase of the feedback transformer reverse the two primary leads of T2.

The purpose of the resistors in series with the primary of the feedback transformer is to limit the base current into the transistors. Also, if the output of the supply is accidently short-circuited, the feedback current drops to a very low value, causing the circuit to cease oscillation. This provides some protection for the transistors, however the circuit is fused as an additional precaution.

The output of the transformer is rectified by a silicon diode bridge. This eliminates heater current and gives a higher output voltage as there is less drop in the silicon diodes than in tubes.

The circuit is designed for 12 volt operation, however, output starts at a low value of input voltage. The same circuit can be used for six volts input supplying 150 volts at about 100 ma. The chart shows the output voltage versus load for 12 volts input using the components shown in Fig. 1.

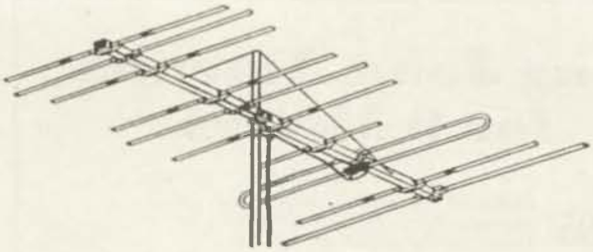
Construction

The supply is built in a 3″ x 5″ x 7″ minibox with all components mounted on the cover. All parts are inside except the transistors.

The case of the transistors is the collector terminal and must be insulated from the chassis. A fiber shoulder washer was used under the mounting nut. Sheet mylar was used between the transistor case and the chassis, but mica or other insulating material with good heat transfer may be used. If there is danger of shorting the case of the transistors to ground where the supply is mounted in the car, a perforated cover could be used to protect them and still allow free air circulation. Use an ohmmeter to check each terminal of the transistors for shorts to the chassis before connecting wires to the terminals. By keeping all transistor circuitry above ground it is possible to use the same supply for either a negative or positive grounded battery by grounding the proper terminal.

. . . W2BXE

Input Current at 12 volts	Output Voltage	Output Current	Efficiency
2.4a	400 VDC	26 ma.	34.9%
4.4a	350 VDC	97 ma.	64.2%
5.8a	300 VDC	160 ma.	69.0%



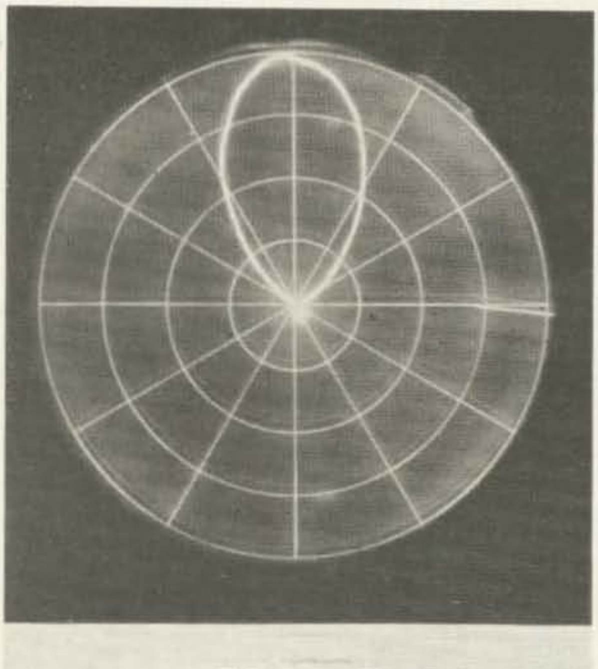
73 Tests the Finney 6 and 2 Meter Beam

Donald A. Smith W3UZN
Associate Editor

WHEN I heard about Finney's new combination 6 & 2 meter High Gain Yagi beam, I was skeptical. When I found out that it had a *common* (single) feedline for both bands I really developed an "I'm from Missouri attitude"! Previous experience with combination beams had not been the best, though I had to admit that it's a lot easier to mount one combination beam on a tower than two separate ones. Then too, at only $33.00 for the beam, I decided to find out just what it had to offer.

Manufacturers use various methods to test and rate their beams, so the first step was to find out Finney's method for rating theirs. As far as I know, they have an exclusive, rather unique way of doing this. The usual method is to make pattern measurements at every 10° or so around the beam. Then a curve is plotted showing the major lobes present. Some minor lobes may not show up in these tests. Finney does it in an entirely different manner.

Finney spins the beam under test at 30 revolutions per minute and develops the pattern of the spinning beam on an oscilloscope! They photograph the face of the scope and retain the photo for their files. Photos are made with the beam operating on at least three frequencies in the band for which the antenna is designed. In addition to the photographed frequencies, many other frequencies in the band are checked, though they are not recorded. One of the actual patterns on 6 meters (at 50 mc) is shown in Fig. 1. One of the patterns for the beam operating on 2 meters (at 144 mc) is shown in Fig. 2. These are the actual photos made when checking out the new A-62 combination 6 & 2 meter beam.



50 M.C.

Fig. 1

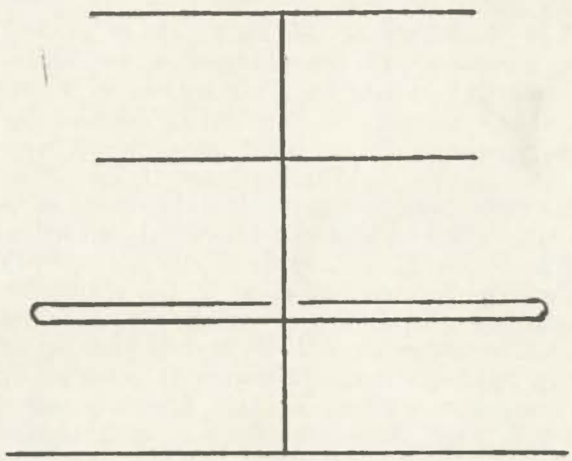


Fig. 3

In regard to gain, the beam when used on 6 meters has a gain of slightly over 8 db when operating on the lower two mc of the band. On 2 meters the beam has even more gain than Finney's own 10 element 2 meter beam! The gain on 2 (at 144 mc), is 14.2 db and increases to 14.9 db or better at 146.6 mc. Front-to-back ratio on six meters is 17 db and 20.5 db on two. Real fine specs all the way around. Believe it or not, the patterns shown, the gain and f/b measurements were made using *one common* feedline for both bands!

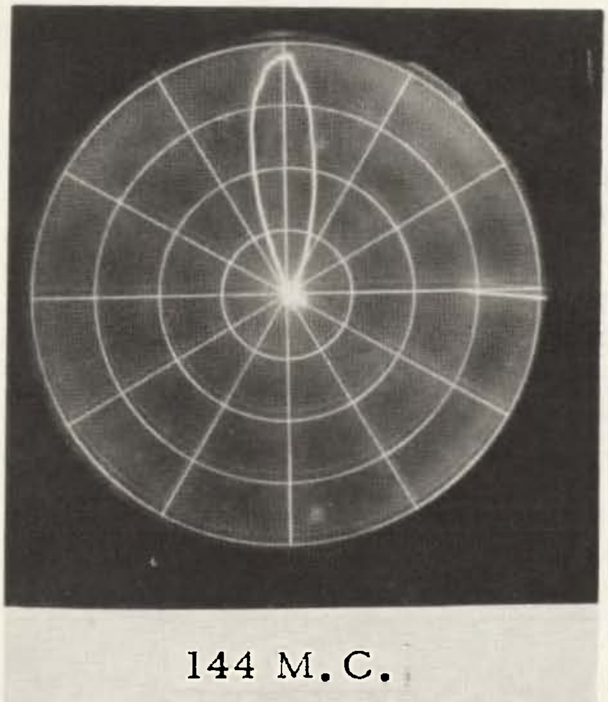


Fig. 2

The theory behind the antenna is very interesting. To begin with, the antenna acts very differently on 6 meters than it does on 2. Take six meter operation for example (follow the sketches). The spacing and arrangement of the elements of the beam result (Fig. 3) in a normal 4 element Yagi, consisting of the driven folded dipole, one reflector and two directors.

On 2 meters, quite a different beam results! The best way to understand its operation is to consider the current distribution on the driven

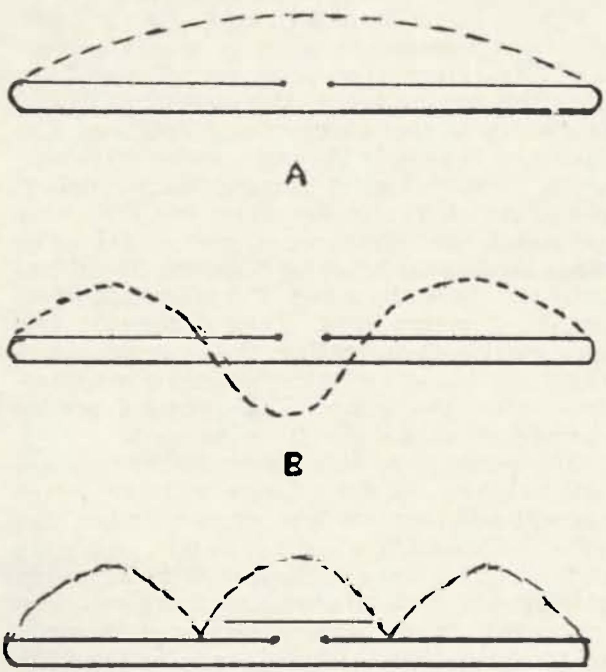


Fig. 4—a, b, c

element (folded dipole), when the beam is used on 6 meters (see Fig. 4a). This is the normal current distribution you would expect. On two meters the current distribution would look like the diagram shown in Fig. 4b. This distribution is not at all desirable, as two positive and one negative loop result, giving an out-of-phase condition and producing a polar directivity pattern with almost equal lobes at right angles in four directions, as shown in Fig. 5.

By adding Finney's patented "Fidelity hPasing Stub," cut to the proper length and spaced properly in front of the driven element, the

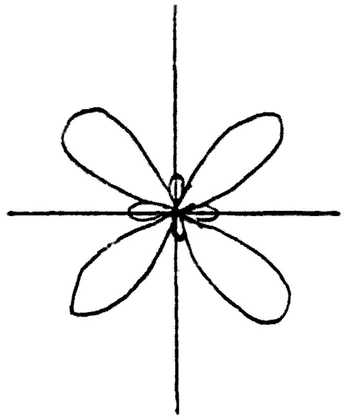


Fig. 5

negative current loop is "phased" and becomes a positive loop, so that the current distribution on the dipole, with the stub, now appears as shown in Fig. 4c. The directivity or polar pattern now looks like that shown in Fig. 6, as the driven element is now an in-phase, 3 element colinear. This is due to the fact that the dipole is three half-wave lengths in the 2 meter band long with the Fidelity Phasing Stub present. (Note that the stub has no effect on 6 meter operation, due to the spacing and length of the stub.)

Spacers (fibre glass insulators), are placed in the elements of the antenna (except for the driven element), as shown in Fig. 7. On 6

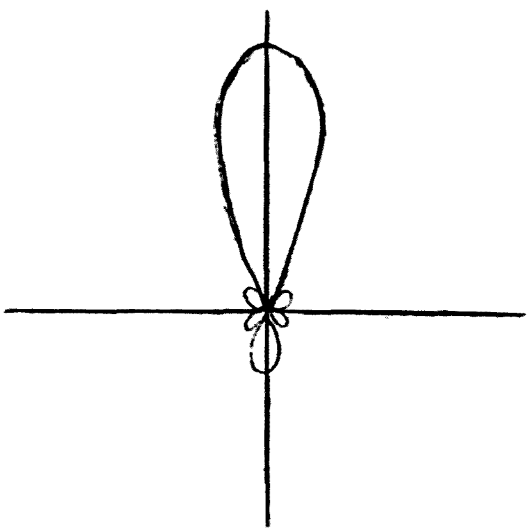


Fig. 6

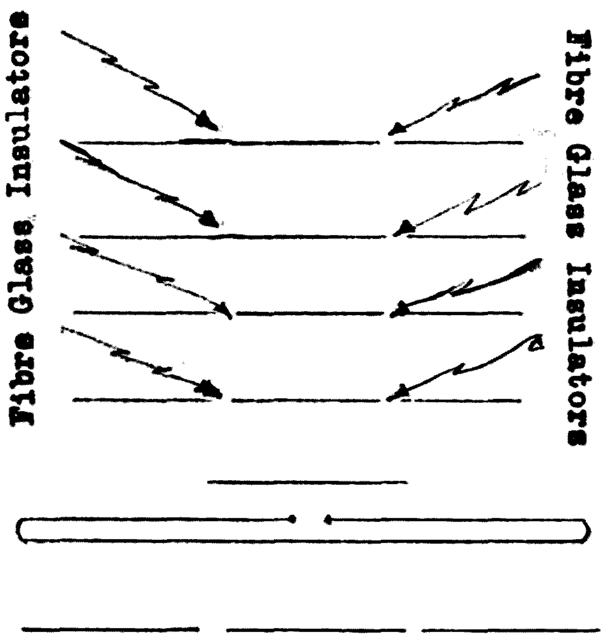


Fig. 7

meters the spacers are not significant as the beam reacts as if these elements were not broken up into three sections. On 2 meters however, the result is the equivalent of three side-by-side, 6 element, 2 meter Yagis fed in phase! (see Fig. 8). To have an array of separate side-by-side Yagis, each would have to have a separate boom, complicating mechanical problems. More important, each of the separate dipoles would have to be fed in-phase and at the same time their combined impedance would have to be matched to the transmission line. Therefore, each of the transmission lines would have to be the exact equal length, tied into a common junction and then impedance matched to a regular transmission line.

Finney has eliminated the mechanical and electrical problems involved in such an array, while retaining the advantages. They have done this by the use of the phasing stub and insulators in the directors and reflector. The operation is exactly the same as the three separate, side-by-side, 6 element Yagis, fed in phase. Actually, this discussion is a little over simplified, as other complications did arise when the beam was being designed. The directors for six meters had a detrimental effect on the 2 meter band. They eliminated this problem by co-ordinating the elements on 6 and 2, so that one of the systems did not interfere with the other. This required precise spacing of all the directors involved.

The result of all this theory is that they are able to obtain, in one antenna with one driven element and thus one transmission line, a high gain 4 element yagi on 6 meters, with the equivalent of three 6 element, 2 meter yagis, side-by-side, fed in phase on 2 meters. You will notice that the gain on two meters is somewhat higher than on 6. This is to be expected, due to the increase in efficiency at higher fre-

quencies (in antenna design), and to the antenna behaving as a 6 element colinear on the higher band, while the antenna is only a 4 element yagi on 6.

As mentioned previously, the driven element is a folded dipole, so the antenna impedance is 300 ohms. Twin lead or open line can be used (which the manufacturer recommends, due to the high losses in coax at high frequencies), or a balun can be used to match the antenna to coax. The balun would be cut for ½ wave length on 6 meters. This will be a 3/2 wave

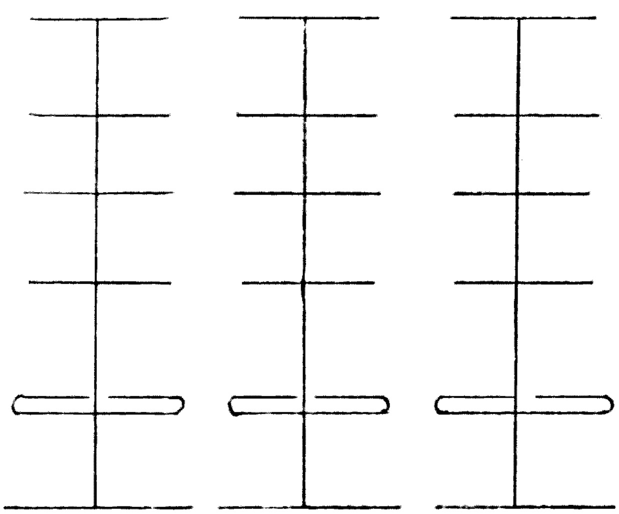


Fig. 8

balun on 2 meters, which will of course be a proper match on both bands. It must be mentioned here that the placement of the antenna, particularly in the height above ground and other objects will to some extent affect the gain and impedance characteristics of the beam on both bands.

In my own particular case, I ran RG-11/U, using the balun cut for a ½ wave on 6 meters. My s.w.r. on 6 (using a Heath reflected power and s.w.r. bridge), was 1.5 to 1. On 2 meters the s.w.r. was 2.1 to 1. This was with the antenna considerably lower than would be desired. The antenna was only 10 feet above the roof of the house. Results with the beam on both 2 and 6 have been much more than satisfactory! On 2 meters it is normal to hear stations in Washington, D.C. and down in Virginia over 100 miles away! Ground wave even brings in stations down in Southern Maryland, at distances up to 175 miles away. These are stations I have never heard before! The beam is very directional on 2, due to the high gain, colinear characteristics, and you have got to zero right in on them or they just won't be there. (Check that antenna direction indicator, fellows!) Next time someone mentions a beam for use on more than one band, I'll be a lot more interested, after this experience. I have learned that it can be done, by proper engineering and careful design plus careful, quality production.

. . . W3UZN

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A New Look At Old Ideas About ANTENNAS

Jim Kyle, K5JKX/6

LIKE weather, everybody talks about antennas but nobody (well, hardly anybody) ever does anything about them.

The result, as you and every other literate ham know, has been an uncountable outpouring of words on the subject. Various authors exhort you to raise your antenna higher, lower it, bury it underground, turn it on end, tune it, not tune it, match it, forget about matching it, and so forth into the hazy distance.

If you're looking for more material along those lines, turn the page and find some other article. This piece has to do with skywires, some new ideas, and some old ones, but one thing it has nothing to do with is exhortations to you to make changes in your antenna if it's working the way you want it to.

Of course, if your trusty length of baling wire draped across the backyard landscape isn't quite doing all you desire, you may feel tempted to make some changes after reading this. But if you do, never claim this article told you to do it. This is information, not detailed direction.

To most newcomers—and not a few old-timers too!—the subject of antenna theory is draped in mystery. The multiplicity of conflicting information already in the literature is largely to blame for this. Back in the ancient days of spark-gap wireless, antennas had no mystery.

Then, you simply put up all the wire you could beg, borrow, or moonlight-requisition, and coupled the rig into it until your lamp-bulb current indicator threatened to burn out.

Primitive? Crude? Inaccurate? Mebbeso, but a fellow name of Marconi spanned a couple of thousand miles of Atlantic Ocean with that technique nearly 60 years back—and that's something a lot of hams frequently find difficult, especially on the lower frequencies where arconi was working.

To a present-day technically-minded ham, who studies Dr. Kraus for a beginning in antenna theory and moves from there to the exotic mathematics of log-periodic calculations, or for that matter even to the average rag-chewer who gets all he needs from the ARRL antenna book, some of the definitions and techniques found in early-day manuals seem laughable.

For instance, they readily admitted that any antenna had a resonant frequency. They explained it like this: Every piece of wire has inductance distributed throughout its length. In addition, an "aerial" (they didn't like that new-fangled term antenna) strung out over the earth had capacity from the wire to ground.

Ground, you must realize, was the other side of the aerial circuit. Nobody even considered working one half of an aerial against the other half, although a few unfortunate souls who couldn't get decent soil under their stations were forced to erect counterpoises.

But to get back to the resonant frequency, that turned out to be the frequency at which the inductance of the wire cancelled out the capacity to ground, in the familiar fashion of a tank circuit.

They had elaborate tables showing how the height of the aerial above ground affected its resonant frequency, and extended calculations to determine the effect of lead-in wires on the system's resonance.

They didn't bother with the little electron bouncing out to the end of the wire, finding nothing there, turning around, and starting back to the transmitter, as we explain electrical resonance in terms of too-long or too-short wires.

And as for standing waves, which possibly have cost more hams more gray hair than any other item (with the possible exception of parasitic oscillations, which have nothing to do with this subject), the old-timers didn't worry. Most of the operators in that day and age wouldn't have known a standing wave if it walked in and sat down. Sure, they had RF in the shack, but that was just a part of this strange thing called radio.

The whole approach sounds a bit archaic in the light of modern theory and training, but did you ever stop to think what you're doing when you add a loading coil or a top-hat to a mobile antenna?

Your main result in either case is the addition of enough reactance, either inductive or capacitive as needed, to make the antenna system resonate in tank-circuit fashion at your operating frequency. And how far removed is that from the old-timer's definition of electrical resonance in aerials?

The idea isn't confined to mobile installa-

tions, either. If you hate standing waves and vertical antennas (some people do, you know) and still don't have room in your yard to sling an 80-meter half-wave, you might try adding capacitance by doubling the wire back.

Modern theory tells us that a linear antenna should be strung in a straight line, but the theory is strangely silent about results if you bend and twist the radiator. Modern theory is silent, that is—the older version says quite directly that you have added capacity and hence have lowered the system's resonant frequency, which is exactly what you set out to do.

If you try this, be sure to keep the wires separated at least a foot or so. This ensures that the RF sees the wire as one long piece and not as a shorter, fatter conductor.

Of course, if you can't keep them separated, try it anyway. A short, fat conductor has greater capacity than a long, thin one, and greater operating bandwidth to boot.

A while back we mentioned standing waves. Most articles these days tell you how to minimize standing waves through perfect matching of the transmission line to the antenna.

In practice, of course, this matching mania can be carried much too far. Several articles in the past two years have pointed out that, once the VSWR is lower than 2:1, you get little more improvement by more careful matching. Yet many hams still worry themselves sick if the meter shows a ratio greater than 1.01:1. They forget that any measurements made at the transmitter end of the line are inaccurate anyway, due to attenuation in the transmission line, and end up devoting much energy to a more-or-less-lost cause.

As a matter of cold, calculated fact, if you ever manage to get rid of every standing wave in the system you'll have a dickens of a time being heard five blocks away—even if you run a California kilowatt.

The reasoning behind this is simple: most antennas radiate because of the large standing wave which exists there at all times. Take away the standing wave, and you take away the antenna's effectiveness.

Exceptions to this rule are the rhombic and similar terminated antennas. However, relatively few hams maintain a farm of terminated rhombics in the backyard.

If you're going to be a perfectionist about matching, how about going one step farther and matching the antenna to free space?

In case you're interested, free space has an impedance of 377 ohms. Applying the basic principles of impedance matching will tell you that an open-circuited 300-ohms line should show little mismatch. Now measure such a line and see what happens. Something's wrong somewhere!

Rather than raise and lower the antenna a thousand times, the simple way to accomplish the same result (of an effective signal) is to tune the line. Pruning accomplishes the same result, but coax is expensive. This will enable the transmitter to operate into a non-reactive load, while conserving energy on the part of the operator. An additional benefit is added reduction of TVI-causing harmonics, because of the extra tuned circuits.

Of course, if the VSWR is too high you still have a possible danger of arcing through the dielectric. In this case, the ancient but reliable 600-ohm open wire line will give good results. It also beats the cost problem, since Sears, Roebuck, will sell you a half-mile of copperclad steel electric fence wire for the price of 100 feet of coax. TVI problems attributed to open-wire line usually result from other causes, and noise pickup is virtually eliminated when an antenna tuner is properly

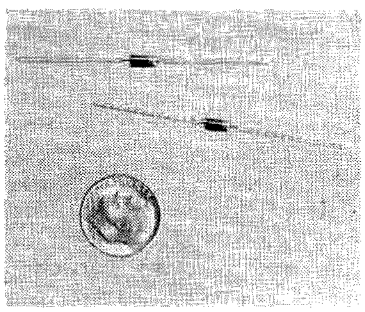
employed. The only disadvantage is esthetic —and who ever claimed a backyard full of antenna wire looked pretty (to a non-ham XYL, anyway) with coax dangling from the midpoint of each strand?

In this brief discourse we've only touched on a couple of points the old-timers know well and modern theorists seems to have overlooked. These are not the only such points; a few hours spent in study of ancient texts can prove rewarding for any ham who holds a three-letter call (and some who hold two). Most public libraries have a good stock of pre-1934 radio books, and many have treatises dating as far back as World War I. Browse through them — you'll be surprised at how much solid operating information was in existence before the days of store-bought stations! ... K5JKX/6

Antenna Relays

For most applications, it is not necessary to invest the money for a coaxial relay to use as an antenna change-over relay. Almost any relay having SPDT contacts with decent insulation will work. Although it is claimed that this will cause a mis-match, waste power, etc. the mis-match is hardly measurable in most cases and the same goes for the power that is supposedly wasted. The only place where a coaxial relay is desirable is on 2 meters, and only because the capacity between the contacts is lower (so is the inductance). In spite of this, I have no problems with a surplus AC relay on 2 meters. If the only objection to an ordinary relay is mis-match, consider the fact that UHF type connectors are not a perfect impedance match by any means, and the coaxial construction of the relay probably isn't either. In some cases, there is more of a mis-match from 2 coax connectors (UHF type) than from a good relay that is not of the coaxial type. ... WA2INM

New Products



Dear Wayne,

Here are some little gems I would really like to rave about. I was naturally a little bug-eyed when I saw the size and efficiency of the KW mobile power supplies

the boys at Jennings were building to run their miniature water-cooled KW mobile rigs. These are the diodes used in the inverters, and they are tickled pink with their performance. When I learned what they could do, I was a little flap-jawed myself. It seems that one of these, the size of a ¼-watt resistor, can handle **three-quarters of an amp** at peak inverse voltages of 200, 400, 600, 800, or 1000 volts (the size stays the same, only the price increases with voltage)—with a voltage drop at full current of about one volt, which means ¾ watt **maximum** of heat needs to be dissipated by the diode. Due to a unique construction feature which incidentally produces high stability, mechanical ruggedness, and miniature size, these diodes will take a square wave beautifuly at frequencies up to 10 kc—which is a real test if you are familiar with diodes—that square wave front can really shake them up. With sine wave, full output can be obtained with inputs as high as 100 kc. Units will operate at anywhere from freezing to boiling. Leads are pure silver. Price is competitive, very much so, even disregarding the added performance features.

Needless to say (but I will) they lend themselves beautifully not only to "big" power supplies, but to relay supplies, bias supplies, meter protection, and semiconductor-capacitor applications (varying from 1 mmf with back bias of —100 v to 15 mmfd at —1 v.); and good old audio clipping, in this case neatly nipping the tops off waves as far out as 500 kc. Made by Diodes Incorporated, 7303 Canoga Ave., Canoga Park, Calif. And they will sell them to hams by direct order. I asked.

Jim WA6EXU

Eddie Tor,

Russ Farnsworth, W6TTB, is kind of a genius on teaching code. Thru many years of teaching the code to groups Russ developed the "word method" and a step by step method of learning the code quickly and somewhat painlessly. Since he is gifted with a very professional-sounding voice, Russ has finally recorded the course on 6 sides of 12" LP's (3 records) in an album selling for $9.95.

During the past year or so the records have become increasingly popular with groups and individuals struggling to master the elusive 13 wpm. Sightless Russ has done a good job of shedding light on the path of code-learners.

Jim WA6EXU

I have one of his albums here Jim and my hat is off to anyone who can fail to learn the code using his method. . . . wayne.

Hiss, Sputter,

Jim Kyle K5JKX/6

SAID one of Lewis Carrol's immortal characters, "When I use a word, it means exactly what I want it to mean—no more and no less!"

This esteemed gentleman wasn't talking about noise in ham radio receivers, but he might as well have been. Because most writings which mention "noise" use the word to mean "exactly what I want it to mean"—and the result is total confusion about this most important receiver problem.

One of the first paradoxes raised by the many meanings of "noise" in receivers is the well known fact that a noise limiter will do nothing at all about noise of the atmospheric sort.

After this opens the door to bedlam, all discussions of noise prevention, elimination, and cure eventually lead to a withdrawal into the corner, muttering beardwise.

So before we get much deeper into the morass ourselves, this looks like a good place to explore the title of this article, the many meanings of "noise," and what we can do about *all* the effects which we dislike.

When we're trying to find out what a word means, one of the most logical places to start is with a good dictionary. Let's see what one has to offer in this case:

"NOISE: 1. A sound that is not musical or pleasant. 2. A sound. 3. Din of voices and movements; loud shouting; outcry; clamor."

Granted, all three definitions given satisfy the general meaning of "noise"—but none of them are directly applicable to any meaning of the word as it's used in radio. Let's look at the physicist's definition of "electrical noise":

"NOISE: An electrical signal having random distribution of both frequency components and of amplitude; evenly distributed throughout the electromagnetic spectrum from zero frequency to infinite frequency."

That's closer. Translated out of the exotic verbiage, this is a precise definition of the kind of noise developed in a high-gain amplifier—the hissing or frying sound which provides an absolute limit to useful gain.

But it doesn't even begin to mention the effect of passing hot-rods. To pick up that definition, we have to go to information theory and the writings of Messrs. Hartley, Shannon, et al:

"NOISE: Any interference with the desired communication during transmission of a mes-

Being a Brief Dissertation on Noise and Such

and Crash

sage; this interference may be from any source, and tends to obliterate a part of the message."

At first glance, you might say that this definition really wraps up the entire problem, since it includes the physicist's "noise" as well as ignition pops, lightning static, and QRM from the kilowatt down the block.

Actually, that's what's wrong with this definition for our uses; it's too broad. When we're trying to find out how to prevent, eliminate, or cure "noise" in a receiver, we want to know what kind of "noise" a given treatment will be effective on. And the information-theory definition is too broad to give us that bit of detail.

Thereby hangs our title: "Hiss, Sputter, and Crash." These three words describe the three kinds of "noise" most prevalent in radio receivers, and by using them instead of the too-general term "noise" we can straighten out most of the confusion.

Hiss, naturally, is the physicist's kind of noise: random voltages which come out as a hiss or frying sound. If you've ever turned a high-gain audio amplifier all the way up with no signal input, you've heard hiss.

Sputter is meant to describe ignition noise, electric-motor interference, and similar annoyances. In a strictly engineering sense, these things are really signals rather than noise, but from the standpoint of communication (where information theory applies) they are just so much noise. Since most of them have a sputtering sound, we picked this name.

The final category, crash, is meant to describe thunderstorm effects and similar happenings. Electrically, these are similar to sputter, but while sputter is reasonably regular (ignition pops show up on every revolution of the engine, etc.) crashes occur only in isolated instances and frequently persist longer.

With the category of effects usually termed "noise" broken down this way, we're now ready to go into them in some detail and discuss elimination, prevention, and cures for all three.

Hiss is inescapable in any high-gain amplifier; that's a fact which must be faced. Any time you increase gain enough, you'll hear it. The reason for this lies in the cause of hiss: it's actually (not just figuratively) the result of the random motion of electrons in each atom of the circuit. The only time it ceases is at absolute zero—and nobody has ever gotten anything that cold.

(Continued on page 68)

(Hiss, etc. from page 67)

However, hiss can be minimized by proper circuit design. The "low-noise" circuits you read about for both rf and hi-fi uses are actually "low-hiss" circuits.

Naturally, the less hiss present the more amplification you can use. However, this fact only becomes important at frequencies above about 50 mc, since at lower frequencies sputter and crash are much more prevalent and mask out any hiss which the receiver may contribute.

For a complete discussion of "low-hiss" rf circuitry, see the technical article "Up Front" in the March, 1961, issue. And remember, wherever the original article says "noise," read it as if it said "hiss."

As we said a couple of paragraphs back, at frequencies below about 50 mc sputter and crash become important. Much effort has gone into circuitry to minimize their effects, and a lot of it has paid off well. Automatic "Noise" Limiters (read it as really being "Automatic Sputter Eliminators") are standard equipment on most receivers these days, and improvements on the standard ANL (ASL) circuits are continually being made.

Naturally, a sputter-eliminating circuit can't do a thing in the world about hiss. The reasons for this lie in the basic differences between the waveforms

The waveform associated with hiss is almost indescribable; since hiss has no specific frequency or amplitude, it's sort of a Heinz mixture of all waveforms. n a scope, it shows up as a rather ragged line. The British term for it is most descriptive of the scope picture; they call it "grass."

On the other hand, sputter has a most definite characteristic waveform. It's sharply spiked, and usually narrow. Most pulses of sputter range in width from one to ten microseconds, which correspond in time to a single cycle of a 2 mc or 200 kc signal, respectively. This, as you can imagine, isn't very long. Crash has a waveform which is something like sputter, but isn't so sharply defined. Like sputter, the wavefront is extremely steep and the peak amplitude extremely high.

Virtually all ANL circuits operate on the magnitude of the signal. An exception is the rate-of-change limiter developed by British TV designers, which is triggered by the steep wavefront.

Both the high amplitude and the steep wavefront are completely missing from hiss. For this reason, no conventional noise-limiter will have any effect on hiss, efficient though the circuit may be with sputter and crash.

By similar reasoning, you can see that the measures taken to reduce hiss will have no effect at all on sputter or crash—except maybe to make them more clearly audible!

In addition to front-end changes to reduce hiss, though, you do have one additional weapon. It's the series-gate trough limiter described in "Stop That Noise!," the technical article for November, 1960, which also included a number of circuits aimed at reducing sputter and crash.

To sum up, then, we must first reemphasize the fact that "noise" isn't always "noise." To deal adequately with the various types of "noise" present in receivers, we've divided them into three categories: hiss, sputter, and crash. Hiss can be prevented by receiver front-end design, or eliminated by a trough limiter. Sputter can be controlled by a good ANL but can be eliminated only at the source, whic usually isn't under your control. Crash w must live with, since man can't yet control th atmosphere and crash is so powerful that most ANL circuits can't handle it either.

Not mentioned are various receiver faults which can result in hiss or sputter. Here ar a few of them (full descriptions must wait for another article):

HISS:

Can be caused by an oscillating tube in rf, mixer, or *if* stages. Sometimes caused by defective volume control.

SPUTTER:

Can be caused by a stage oscillating far from normal operating frequency (parasitics, in other words). Occasionally caused by arc in power supply or defective rectifiers.

. . . K5JKX/6

(Letter from page 47)

ıgainst that sick-humor suggestion of yours that Extra Class licensees be granted the privilege, if that's what t is, of picking out calls like W2SKIDDOO, etc. Goodıess, Wayne, don't drag the flag, dive with the hatch ıpen, trade for a pot of message—what am I trying to hink of? No sir, let's hold out for something good, like ılack Homburgs, or rehabilitation at public expense. Extra Class has been a big zero for nearly a decade; vhat have we got to lose? Thing bug—I mean big.

Ken, W7IDF

P.S. Otherwise the idea of a fee for licenses is fine. Ve use the F.C.C. and we can pay for the service. The armers can pay for the Weather Bureau and the boatuts for the Coast Guard. After all, the Postmaster ieneral wants to run his show this way, and why not? 'ay for what you get, and no more taxes for what you on't use. Is that what you mean by Goldwater Repubicanism? I'm with you.

Mother and son subscriptions special this month, two for 5.00.

(Propagation from page 49)

t each end of the circuit. B.) To work the ıath New York to San Francisco (2,600 ıiles), the local time centered on the mid-point f the path will be 1½ hours later than at ian Francisco and 1½ hours earlier than in Iew York (the time difference between New 'ork and San Francisco is 3 hours). Looking p the HBF's next to the 2,500 mile listings vill give the HBF to use. In San Francisco ubtract 1½ hours from the time periods listed or local time and in New York add 1½ hours) the time periods listed for local time.

These charts are to be used as a guide to Iam Band openngs for the Month of August, 961. I am interested in hearing of your reılts using these charts and will consider any equests you might make for the inclusion of ifferent areas in the DX chart.

(W2NSD from page 41)

ntenna. Too bad it is too big a deal for six ıeters.

The panadaptor article came in second. It 'as close enough so that I had some nervous ıoments thinking about my policy of paying alf the original price to the winner each ıonth. Abe got 1891 votes to 1779 for Panaaptors, which is close. The staff article on ower supplies came in a healthy third, again stifying that we're on the right track in preınting technical articles that are written for ıe regular amateur instead of the engineer. he article on capacity measurement by John einartz K6BJ was fourth. It sure is nice to ave John with us, his articles are always of igh interest.

VOX POPS

Here are some of the comments received in

(Turn to page 71)

Advertisers

Air Electronics 53
Alden 65
Alltronics-Howard 70
Arrow Electronics 9

Cabral Motors 41
Candee 25
Centimeg 51
Central Electronics 19
Clark 70
Clegg .... Cover II
Columbia 64
Cubex 68
Cushcraft 53

Drake 27

Ebco 29
EICO 3
Electro-Physics 53
Epsilon 67
E-Z Way Towers 4

Finney 17

GAM 7
General Electric 31
Graham 70

Heath 21
Hi-Par 55

International Crystal 5
Irving Electronics 67

Jefftronics 69
JSH 57

KTV 71

Lafayette Radio 73
L-W Electronics Labs 67

Maps 66
Mini-Products 51

National Radio .... Cover IV
Novelties 70

Petersen .... Cover III
P & H 57

Radio Bookshop 60
Radio Industries 45
Rex 71
Reyco 70
Rider 11
Roberts (J-Beams) 71

Seco 15
Shure 59
Skylane 65
Springfield 70
Subscriptions 4

Tapetone 69
Technical Manuals 70
Technical Material Corp. 13
Telrex 63
Texas Crystals 47

VHF-UHF Assocaites 45

Western Radio 49
World Radio Labs 23

(W2NSD from page 69)

answer to the "Articles I would like to see" blank in the June issue of 73. This should answer the question posed by many writers: "What should I write about?"

The ultimate conversion of the HQ-129X. VHF construction. RTTY info. Halos by K2TKN. Simple test and measuring inst. HF & UHF antenna articles. VHF transmitter & receiver construction. VHF articles. *Simple* VHF construction. 88-108 mc FM tuner. Surplus conversions and data. Transistor equipment. Simple electronic key with no relays. The hows and whys of amateur television and facsimile. More on AM modulation. Station control unit. L networks 52 ohms into 52-500 ohms. Dope on RT91/ARC-2 transceiver. Impedance matching of antenna. More on panadaptors, Antenna tuners. RF indicators. More DX information. Power meter and SWR bridge that can be left in line. Scratchi? Antenna loading theory. RTTY for beginner. Parametric amp for 220 or 432 mc. Semiconductor power for two 6146's in 12v mobile. Fearless survey. 6M Abe Lincoln.

Dimensions for cutting coax to fit various connectors. Accurate frequency check or measuring equipment for mobile. Bias shift modulation. Low power transistor transmitters. Conversions of R28/ARC5 and R89/ARN5 receivers. Deluxe homebrew SSB exciter, not phasing type, with PTO. More by Reinartz. Keyer construction. Mobile transmitters. R7/APN1, BC652, RAX-1. Simple VHF antennas.

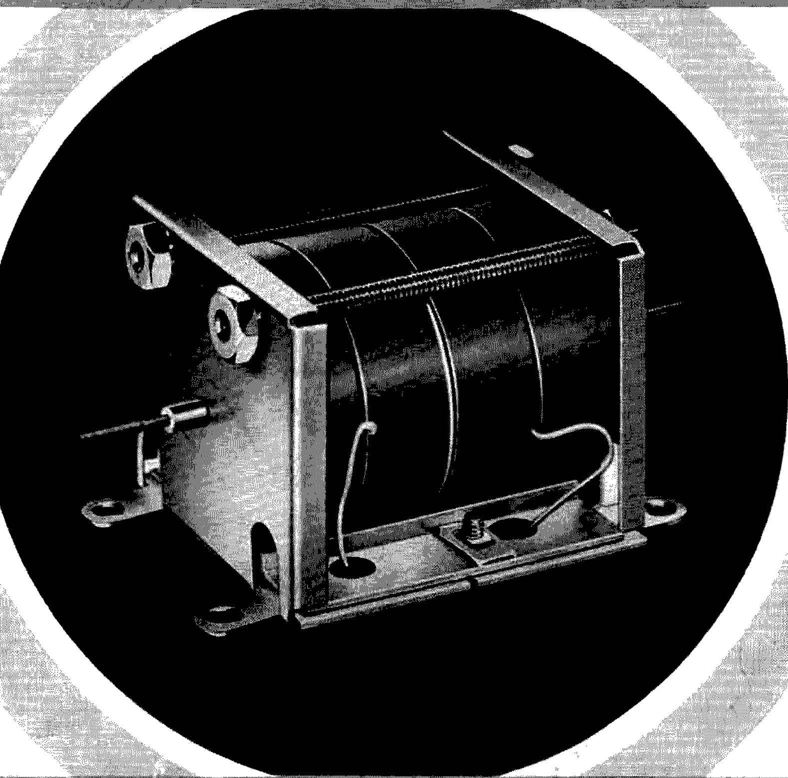
Hundreds of cards asked for more VHF articles, dozens for RTTY. Antennas are very high in interest, both HF and VHF. I have articles on hand, bought and paid for, covering many of the requests, but as you can see from the sample above, the demand is unlimited. You convert it, we'll print it. You build it, we'll print it. You explain it, we'll print it.

W4BPD

A letter just came in the other day from Ack, W4ECI of Birmingham, telling of the new DXpedition planned by Gus Browning W4BPD. Gus made quite a trip last year, as those of you who chase DX well konw, and found out how to go about getting licenses for operation in many of the rare countries.

After hearing Gus tell about the trip in rather good detail at the Miami Convention in January I made him promise to write an article on his methods for brainwashing the local officialdom of these countries. Gus came through in good fashion and we will be printing this in our October First Anniversary. We've Made It For A Whole Year Issue. Gus used a different approach and it certainly was effective. After reading his article I think most of us will be able to go into just about any of the smaller countries and get a license.

. . . de W2NSD



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National's patented Ferrite Filter provides instantaneous selection of 5 kc, 3 kc, and 0.6 kc bandwidths *plus* 2.5 kc selectable sideband with no extra filters to buy! It's available only in National's new "Cosmic Blue" NC-270!

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Make Sure You Check These Features Of The NC-270: 6 meter band included, (no converters to buy); sensitivity—1.5 uV for 10 db signal to noise ratio; product detector for SSB and CW; Bi-Filar T-Notch Filter with external depth control; built-in 100 kc calibrator; extreme mechanical and electrical stability; compact, modern styling—the NC-270 includes National's "Flip Foot" for maximum operating convenience . . . plus many other features.

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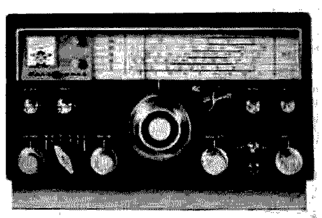
Suggested cash price: $249.95. NTS-3 Matching Speaker: $19.95 (slightly higher west of the Rockies and outside the U.S.A.). **Most National distributors offer budget terms and trade-in allowances.



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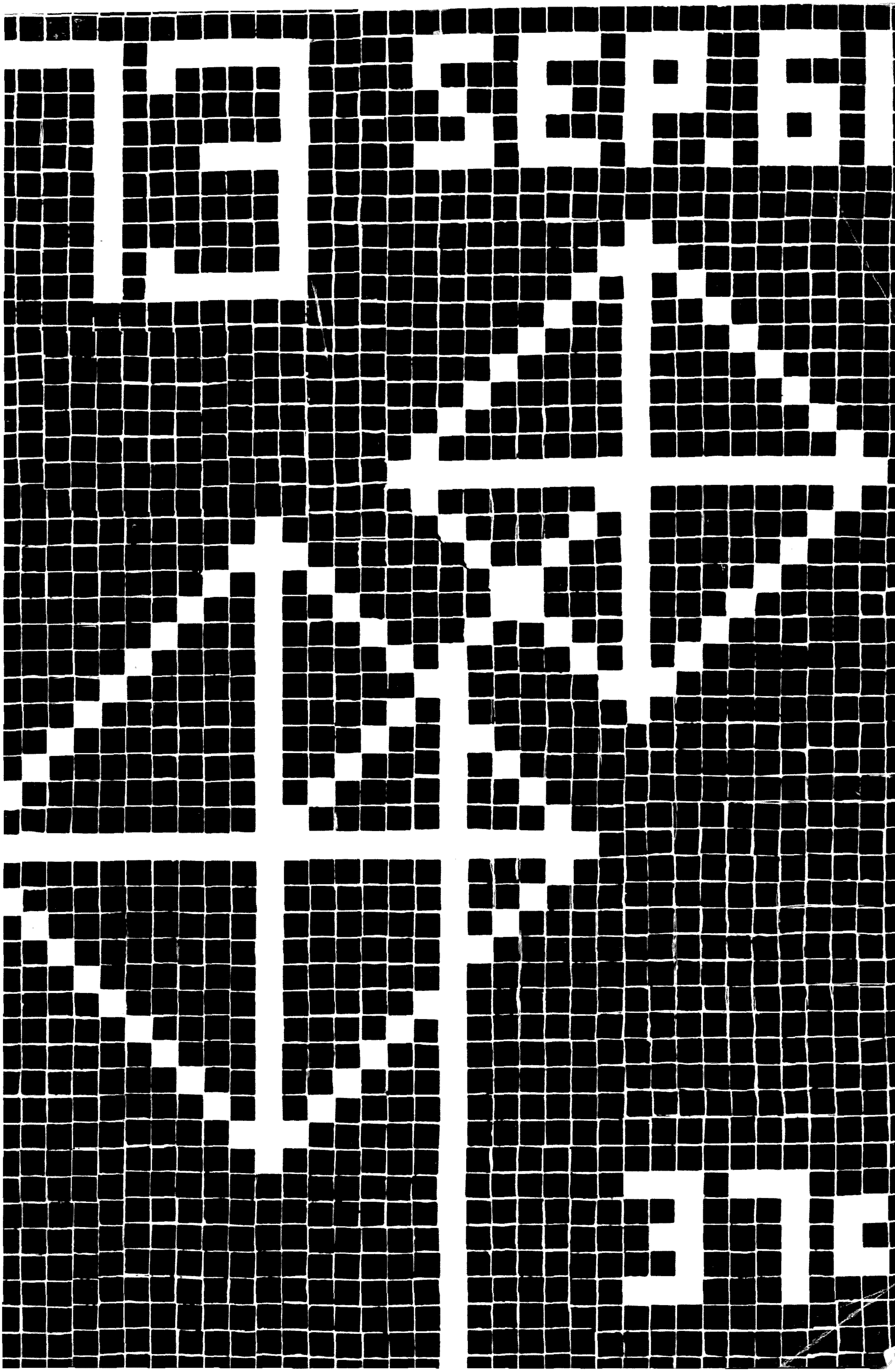

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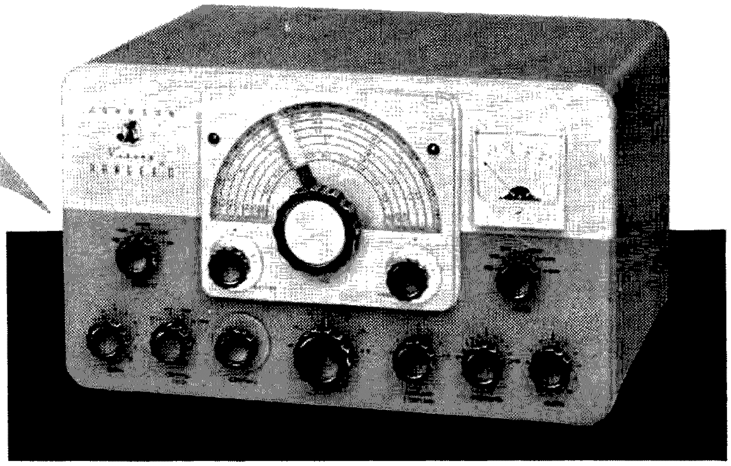
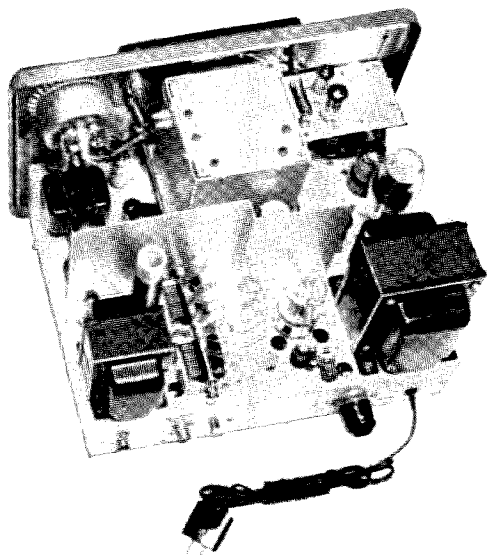
NOW COVERS 6 METERS IN ADDITION TO 160, 80, 40, 20, 15, 10



75 watts CW input ... 65 watts AM!



Now—a new version of the popular Viking "Ranger" . . . the "Ranger-II" Transmitter/Exciter! Completely self-contained in a handsome re-styled cabinet, the "Ranger II" now covers 6 meters! As a transmitter, the "Ranger II" is a rugged and compact 75 watt CW input or 65 watt phone unit. Pi-network coupling system will match antenna loads from 50 to 500 ohms and will tune out large amounts of reactance. Single-knob bandswitching on six amateur bands: 160, 80, 40, 20, 15, 10 and 6 meters—built-in VFO or crystal control. Timed sequence (grid block) keying provides ideal "make" or "break" on your keyed signal, yet the "break-in" advantages of a keyed VFO are retained.

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73 Magazine

1379 East 15th Street
Brooklyn 30, N. Y.

September, 1961
Volume 1, Number 12

Contents

Silicon Rectifiers .... Henry Cross W1OOP 6
How not to pop 'em, a lesson for hams and engineers alike.

Tuning Bypass Condensers .... Jim Kyle K5JKX/6 8
How to make a bypass bypass at the VHF's.

Simplescope .... Harvey Pierce WØOPA 10
Perchance the title may give this one away. You need one. Build it.

VFO Chirp VS 6AU6 .... Al Brogdon K3KMO 20
Several VFO's use a 6AU6. Lousy choice, try a 6AH6 instead and see.

Console .... Beryl Dassow W9HKA 22
If you're going to be obstinate enough not to buy an Alden Hambench, then build this.

Class B Modulators .... Larry Levy WA2INM 28
We'll print anything.

Eye for Resonance .... Roy McCarthy K6EAW 30
How confounded simple can a GDO get? This is how simple, that's how.

Break-in A la Transwitch .... Ernest Austin W7AXJ 33
Complete station control unit, transistorized.

Environmental Testing .... Joseph Leeb W2WYM 36
Be nice to surplus gear, it has been through a lot.

Band Edge Marker .... Charles Berner WA2HRZ 37
A 3.5 mc crystal calibrates your receiver on all ham bands.

Tell The World .... J. Kyle K5JKX/6 39
Ham radio needs publicity, here's how to go about it.

Zero Shift Keying .... Kyle K5JKX/6 42
A new idea, presented first in 73. You'll be hearing more about this.

Cross-Polarized Beam .... George Messenger K6CT 48
A new approach to diversity transmission and reception.

Crystal Oscillators .... Staff 50
This is the Big Technical article. You'll find it interesting.

Propagation Charts .... Dave Brown K2IGY 64

Why a 73 Page Magazine Is Impossible .... Wretched Coward K2PMM 72
or: further developments of the KW Transistor Transmitter.

Misc.:

Editorial de W2NSD 2
Club Subscription Rates 4
Snap Bushings 20
Letters to Editor 29, 49, 63, 68, 69
Pi nets 38
Typical 73 Subscriber Shacks 46
SX-101A Note 49
MARS Technical Broadcasts 63
Ham Headlines 66
New Books 66

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... de W2NSD

(never say die)

Reciprocation

Senator Barry Goldwater has just introduced a bill into Congress to permit reciprocal licensing of amateurs. It was referred to the Committee on Commerce. Please write immediately to your representative in Congress asking for support of Senate Bill S.2361. Here is your chance to be a hero, don't muff it through laziness or disinterest. Sit down and write. This could have far reaching results toward preserving our frequencies in the long run.

Get Rich Quick

Nonsense, of course. Well, as mentioned an issue or so back, I'm anxious to make some information available at low cost that might not otherwise see print. We're getting set up to publish small booklets, between ten and twenty pages long, right at our 73 office. This will keep costs down, keep me out of trouble running the offset press and Varityper, and make it possible to make these available at a low price.

This will also make it possible for us to pass along a good piece of the income from such a venture to the author of the booklet. I figure we can put out the booklets for 50¢ to 75¢ each and return 20% of this to the author. This means up to $200 for every thousand booklets we sell. OK, stop fidgeting. I'm open for suggestions as to the subjects. One benefit of publishing small booklets is that they can cover one particular subject quite thoroughly and don't take the year or so of work that a regular book does.

Suggested subjects: Nuvistor circuits compendium and discussion; De-noising cars; Mobile antennas; Conversion of Motorola FM gear for ham use; Complete receiver construction articles; Antennas for 1296 mc; How RTTY Works; RTTY Converters; What TT printers to get and where to get 'em; How to keep a ham club alive and kicking; Roster of 432 mc stations; Who's Who on 1296; etc. If you can think of a subject that you think 1000 people will pay 50¢ to read about then check in to make sure that you arent' racing someone else on the same subject.

Once published, we'll keep the booklet in print as long as it continues to sell. We'll push it in 73, you may be sure, and we'll not only sell it directy but have it on sale in as many radio parts distributors as possible. Most booklets should sell well over 10,000 copies . . . none of the seven books I've produced in the field have sold less!

Bulletins

It is probably bad policy to tell everyone what we're planning for the future, but I'd like to see the reaction and a little discussion of it might just get someone thinking.

Our policy, right from the start, has been not to have any monthly activity columns in 73. There is no notion of changing that. We've proven rather conclusively that there is no need for more columns. But there is a need for communications between fellows with similar interests. RTTY never got off the ground until there was a bulletin keeping everyone in touch with the happenings in the field and serving as a clearing house for operating news and technical discussions.

At present 73 is subsidizing the "73 News," put out by Marvin Lipton VE3DQX. This is a monthly paper which is sent out to all of the editors of ham club bulletins around the country (and the world) to give them news flashes of interest to help them with their bulletins. If the number of club bulletins coming in here with notes of credit to "73 News" is any indication, Marvin is doing a splendid job.

Undoubtedly there is a need in many other ham fields for a bulletin to exchange information. It is a lot of work to put out something like this. I've been through it myself, so I really know what it is all about. I started mine with a circulation of 50 on a hand mimeo and wound up with over 2500 three years later using offset printing. This was what got me into the publishing field originally and look what happened! With that warning I suppose I have discouraged you.

Though we have over two hundred thousand hams in the country, there are only a few who have the drive to take things into their own hands and do something about problems. We have a need for communications in many fields and a lot of good would be done if people were to suddenly decide to start a bulletin in that field. Note: most everyone will cooperate with you and send in information, but there will be a few who will fight you tooth and nail just on general principles. They want to know who the hell you are to set yourself up as the big cheese, etc.

Ditto and mimeo machines are quite inexpensive in used shape and are invaluable to the bulletin producer. It is amazing how these things grow. I now have a small mimeo, a large mimeo, a Ditto, five different types of typewriters and a Varityper. Next comes an offset press, a stapler, and a large paper cut-

"Terrific!...Unbelievable... Best rig—ever"!

Here are a few unsolicited comments from owners of Clegg VHF equipment

Clegg Zeus VHF Transmitter FOR 6 AND 2 METERS

A highly efficient, 185 watt AM, high power VHF transmitter for full coverage of the amateur 6 and 2 meter bands and associated Mars frequencies.
Automatic modulation control with up to 18 db of speech clipping provides magnificent audio with "talk power" greater than many kilowatt rigs.
This beautiful unit with its ultra-stable VFO is the ultimate in VHF equipment for amateur and Mars operation.

99'er Transceiver FOR 6 METERS

This completely new transmitter-receiver is ideal for both fixed station and mobile operation. Small in size, low in cost, and tops in performance, the 99'er offers operating features unequalled in far more costly equipments. The double conversion superhet receiver provides extreme selectivity, sensitivity and freedom from images and cross modulation. The transmitter section employs an ultra-stable crystal oscillator which may also be controlled by external VFO. An efficient, fully modulated 8 watt final works into a flexible Pi network tank circuit. A large S meter also serves for transmitter tune-up procedure.

From Ohio:
". . . I am a quality control supervisor with a leading electrical manufacturer and this Zeus transmitter is to me the finest piece of workmanship that I have ever purchased or inspected . . ."
Richard E. Hayes, K8UXU

From New Hampshire:
". . . We feel that our new Zeus is the best thing that ever happened to us since we have been in ham radio (5 years) . . ."
Hazen & Beatrice Bean, K1JFQ

From Florida:
". . . We are well satisfied with the results of this unit as we have worked forty DX contacts in little more than three hours on May 23, 1961, including six new states which we were unable to work in the past two years with a 120 watt, 6 & 2 transmitter of a different mfg. . . ."
Jack Edlow, K4YIW

From California:
". . . Never before have I been more pleased with a piece of gear than I am with my Zeus. In two days I have worked 24 states with several contacts in each, (phone) on six meters. And the signal reports—yow! For the most part unbelievable . . ."
Jeanne & John Walker, WA6GEE

From Pennsylvania:
"Words cannot express the pleasure and performance of ZEUS. I have worked 5 states 5-9, plus I have given you $1,000,000 advertisement . . ."
Dr. A. Schlecter, K30EC

From Puerto Rico:
". . . I want to inform you of the excellent results obtained with the Zeus Transmitter I bought one month ago. Taking advantage of the band opening, I have been able to work up to the present thirty-eight states, including California . . ."
Pedro Fullana, KP4AAN

From New Jersey:
". . . I would like to tell you I am more than delighted with the operation of the Zeus. Have had nothing but good reports from other Ham's . . ."
Donald E. Gillmore, WA2QCQ

From Georgia:
". . . This set is terrific. I've had terrific results with it. It's the best rig—ever."
George E. Missback, K4QOE

K8CHE in Ohio tells about 99'er
". . . with the 99'er haywired in from a four element beam, through 100 feet of coax, through a matching network, through a length of 72 ohm twinlead, and then through a length of 300 ohm twinlead to reach the 99'er, we could read the Michigan stations Q5! and back through the above haywire we were able to put 4.4 watts into the antenna as measured by a RF ammeter! . . ."
Ken Phillips, K8CHE

Clegg LABORATORIES
504 ROUTE 53, MT. TABOR, NEW JERSEY • OAkwood 7-6800

ter (I have a small one).

Once you have the machinery you can start by mailing your first thin bulletin to those few chaps you know who are interested in the field. Ask them all to recommend more readers. By the time you are putting out the third or fourth issue you will have most everyone on the list.

What fields are there? Lots come to mind right way. Ham TV, FAX, 220 mc, 432 mc, 1296 mc, contests, 2M SSB, 6M SSB, 75M DX, 160M DX, plus bulletins on VHF, SSB, awards, DX, etc., which would stress different aspects than are being covered by presently published bulletins. You can probably think of some that I have missed.

You'll never get rich putting out a bulletin, but you will have more fun than you've ever thought possible. I'll help anyone that wants to get started in any way I can (I'm short of money right now, but maybe by next year, if a few more advertisers will start using 73, we'll be in shape to even help that way). We'll give you every hand we can through the pages of 73 also as long as you don't tie up too firmly with other publications.

Changes

The result of the poll on our diagrams was in favor of the gray background. We'll try to get the engravers to make the gray lighter and the diagrams larger. I get just as distressed as as anyone when I see how small some of them come out. Absurd. We topped ourselves last month with the construction details on the Impedance Bridge. I'm having larger copies made of them for anyone interested in building the instrument. These should be available any day now for $1. I'd like to send 'em out free, but we're constantly shying away from bankruptcy and I don't want to topple us. By next year we should be able to do things like that for the fun of it. We will if you'll keep needling those non-advertisers.

(Turn to page 69)

Club Subscriptions

As announced a few months ago, clubs may send in group subscriptions at the rate of $2.50 per one year subscription in groups of five or more subscriptions. These subs must start with the next published issue and be for just one year. Orders for back issues should be sent in separately. By simplifying the procedure we can offer this reduced rate.

The regular subscription rate is $3 per year; $5 for two years; $4 per year for DX operators outside North America. All back issues are 50¢ each. Send your name, call and address to 73 magazine, 1379 E. 15th St., Brooklyn 30, New York. Include money.

Silicon Rectifiers

and how not to blow them up

Hank Cross W1OOP
111 Birds Hill Avenue
Needham 92, Massachusetts

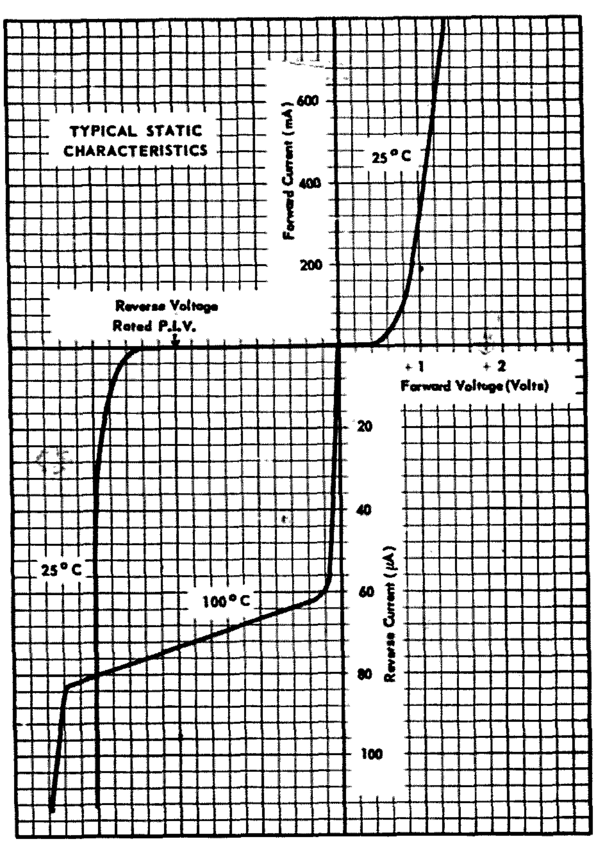
MANY hams and engineers that I know are mad at silicon power rectifier diodes. They tried them once and the results were disastrous. (The engineers are madder, because they thought they knew what they were doing). Nowadays the diodes are better and cheaper, and people are still popping them.

What Not to Do

If you own a slide-rule and a scope, plus lots of diodes, you can work out how to get away with almost anything in the way of a circuit. For the simple way out, avoid:

Choke Input Filters. When you open transformer primary, diodes get voltage surge, blow up.

Half Wave rectifiers, except direct off the line. That unloaded transformer is murder on the backswing.



What to Be Sure to Include

A Series Resistor. For 115 volt rectifiers, ten ohms seems adequate for all commercial diodes. Transformer secondary dc resistance should be at least six ohms per hundred volts, add some if there isn't enough.

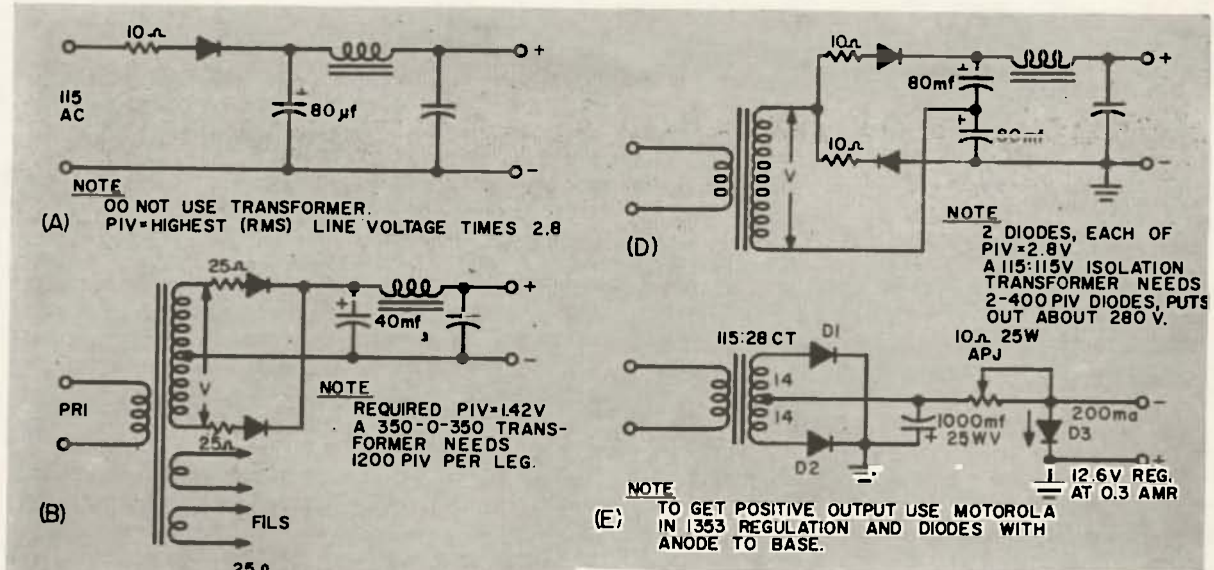
A Fuse. Secondary fusing (NOT a slo-blo) is smartest. Even 83's put out less into a short. And transformers cost money.

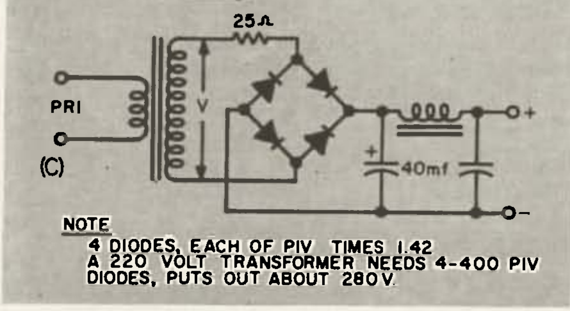
Enough peak inverse rating to do the job. Most small silicon diodes die of back voltage. My "115 volt" line went up to 138 without help from a variac one night: that's 200 peak or 400PIV for an ac-dc rectifier. My silicons didn't go, but a 500 volt electrolytic spread Reynolds Wrap all over the shack! (The power co. said it was a defective regulator). If you replace a 5Y3, 5U4 or 6X5 with silicon diodes, do not be surprised if the transformer runs hotter. Adding series resistance to replace the "plate resistance" (about 200 ohms in the case of a 5U4) will cool things down, if you want.

Ratings

Figure 1 shows the "plate characteristic" of a silicon diode—almost any diode. A volt in the right direction makes amperes flow; a good diode has a fraction of a microampere of leakage at room temperature in the reverse direction, up to the "avalanche" voltage, which depends on the diode and the temperature. Lower temperature gives less leakage and LOWER breakdown voltage; higher temperatures (up to that of melting solder at or near the junction) give greatly increased leakage, higher avalanche voltage, and slightly less forward drop (at least for low forward currents).

The surge and forward current ratings are set so as not to melt the working parts; the rated PIV (peak inverse voltage) is picked so that it's below the avalanche voltage at minus 65C, even (a comforting thought). For some reason (such as fairly fancy testers) diode manufacturers don't put in a factor of





safety—you have to do that. A term, "maximum allowable RMS voltage" shows up on some rating sheets: it usually means that you could test the diode into a resistor at that voltage, but in any real circuit half as much voltage would be excessive, so forget it.

For a GE 1N1490 (to pick a type that I have used a lot of) the ratings read:

Maximum allowable PIV	400 volts
Maximum allowable RMS voltage 280 (see remarks above!)	
Maximum allowable continuous reverse dc voltage	400
Maximum allowable dc output at 125C ambient	250 ma
Maximum allowable dc output at 25C ambient	750 ma
Maximum allowable one-cycle surge current	15 amps
Max. full-load forward drop	0.55 volts
Max. leakage current, full-cycle av at 125C	0.3 ma

The power lost in leakage and in forward drop are about the same at 125C, which is hotter than I would run *any* silicon diode for any length of time beyond a few seconds.

What this means can be shown by some circuits. Figure 2 A using a 1N1490 will take 117 ac and give about 150 dc at up to 500 ma.

In circuit 2-B you'd need three of these diodes in series for each side of a 350-0-350 volt transformer, and get about 400 out under the transformer's rated load . . . six in all for 300 mils out of an old TV transformer.

The bridge rectifier in 2-C could use a 110 to 220 volt isolation transformer (sold as a 220 to 110, most likely) to give 280 volts at 300 ma continuously with a 100 watt transformer, such as Stancor P-6383, and a 125 mfd input capacitor.

Figure 2-D shows how to get 280 volts dc from only two diodes and a 115 to 115 isolation transformer. A 50-watt unit is good for about 125 ma. Popular in modern TV sets.

In any of the above circuits, more output voltage than the example requires either higher PIV diodes or more in series. The price of diodes above 600v is quite high; at present it is cheapest to buy 400 or 500v units and put them in series.

Replacing Seleniums

The rules are simple: a six-plate selenium stack equals a 400 PIV silicon diode. An eight-plate stack should be replaced by a 500 or 600 PIV silicon. In choke-input circuits using seleniums, where the selenium rectifiers have "aged" but are not burnt, put the silicon diodes *across* the seleniums, and let the seleniums soak up voltage surges to protect the silicon junctions.

Heat Sinks

The bolt-on silicon diodes are used for higher average currents, but in many cases there is no need to bolt them to anything better than a solder lug. Rather than use mica washers and risk shorts, I prefer to bolt the diodes to individual plates of 1-16 in. aluminum and insulate these plates, such as with threaded ceramic standoffs. These cooling fins should usually be vertical. By picking circuits, it is often possible to run the diode cases at ground potential and avoid insulating, as in Fig. 2-E. The voltage regulator or "Zener" diode is what gets hot, so pick the polarity to go with your diode. . . . W1OOP

Tuning Bypass Capacitors

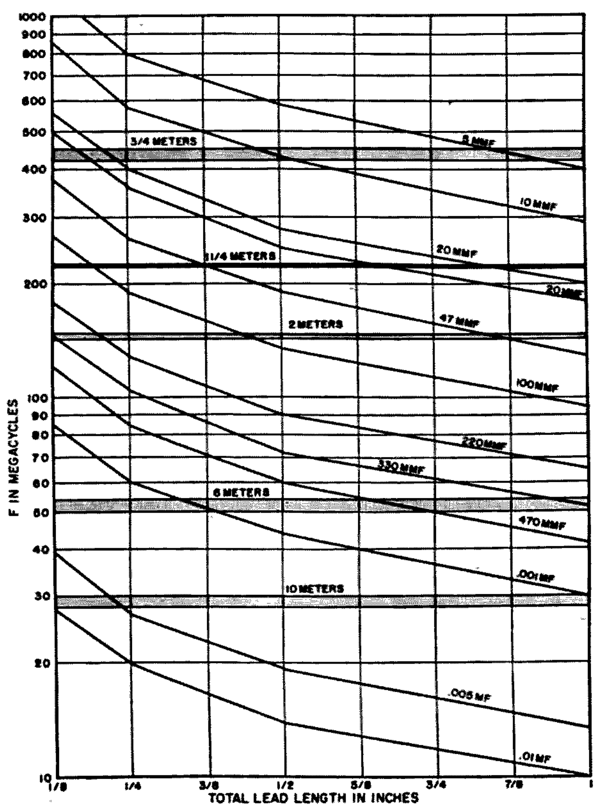
Jim Kyle K5JKX/6
1851 Stanford Ave.
Santa Susana, Calif.

ESPECIALLY in the VHF regions and above, bypass capacitors can prove troublesome in both receivers and transmitters. Almost all commercially produced capacitors have some inductance too, and in addition the inductance of the capacitor leads becomes important at frequencies above 30 mc.

The purpose of a bypass capacitor is to be a short-circuit path for radio-frequency currents while isolating dc voltages from ground. Since inductance impedes the flow of ac, and the impedance of any given inductance increases with frequency, the inherent inductance of the leads and the capacitor itself produces an upper limit to the unit's effectiveness.

Conventional paper capacitors are almost useless for bypass purposes at any frequency higher than 500 kc; in the higher frequency ranges, disc ceramic capacitors are to be preferred since their flat-plate construction reduces inductance to a minimum. However, even these units are not usually recommended for use above 300 mc.

Normal construction practice for installing bypass capacitors is to make the leads as short as possible to reduce any inductance contributed by them to an absolute minimum. As an example, a one-inch length of No. 20 wire has an impedance of 8 ohms at a frequency of 60 mc, and this 8-ohm impedance is enough to seriously upset the action of an otherwise-normal amplifier circuit.



Not so well known—although it was first described in 1948—is the fact that this lead inductance can be used to tune the capacitor to frequency, thus extending its use to frequencies higher than the normal limit and at the same time making its action more efficient than is otherwise possible.

For instance, a 470 mmfd capacitor with no inductance at all would have an impedance of approximately 6 ohms at a frequency of 50 mc. The same capacitor, if installed in a circuit with a total lead length of ¾ inch (say ⅜ inch for each lead), would exhibit approximately 0.25 ohm impedance at the same frequency—a 25-fold reduction in impedance.

We said earlier that the upper limit for normal disc ceramic capacitors is in the neighborhood of 300 mc. By using the leads to tune the capacitor to series resonance, this limit can be extended upwards to more than 800 mc—enough to allow operation on another band.

Here's what happens: The inductance of the leads, and of the capacitor itself, is used to tune the capacitance to series resonance at the operating frequency. If circuit Q were infinite, the impedance at resonance would be zero; however, with circuit Q as low as 5 (and it's usually higher than this) the resonant impedance is still less than 0.25 ohm.

Inductance of the wire normally used for leads on disc ceramic capacitors is approximately 25 millimicrohenries per inch. If you like, you can plug this into the resonance formula and calculate length for yourself.

However, to save you the trouble, we've calculated the values for the range from 10 mc to 1000 mc, lead length from ⅛ inch (the shortest usually found in practice) to 1 inch, and selected capacitor values from 5 mmfd to 0.01 mfd. The result is the graph shown in Fig. 1.

To use the graph, first find your frequency on the left-hand scale. Reading across, you'll find several diagonal lines which intersect the frequency line. Each of these represents a usable value of capacitance. Read downward from the intersections to the lower scale to determine total lead length necessary for series resonance.

A couple of words of caution are indicated at this point. First, total lead length means the length of one lead added to the length of the other. If the graph says ⅝ inch, one lead can be just 1/16 inch long and the other 9/16, or they can each be 5/16 inch, or any other combination which totals ⅝ inch. Secondly, since capacitance values are rarely more accurate than 20 percent, the best bet is to cut the leads a trifle longer than indicated and then to dip the unit to frequency with a GDO.

When possible, it's best to use the highest-value capacitor that can be resonated. The reason for this is that the effective bandwidth will be greater and the circuit will be more tolerant of errors.

For example, to quote directly from Volume 18 of the M.I.T. Radiation Laboratory Series, on page 326, if a 500-mmfd capacitor is resonated at 60 mc, the range over which its impedance is less than half an ohm extends from 57 to 63 mc. For a series-resonant 0.002 mfd capacitor, the corresponding range is from 50 to 72 mc.

This trick may also be used to help suppress harmonics and subharmonic feedthrough in transmitters, by deliberately using the smallest possible capacitor and resonating it very carefully to frequency. Because of the low capacitance and narrow series-resonant bandwidth, the capacitor will be effective only at operating frequency. At lower frequencies it will be a large capacitive impedance, and to harmonics it will look like an rf choke since a resonant circuit appears inductive at frequencies higher than resonance. In both cases, the result will be negative feedback to all signals except those at the chosen frequency, which will go through unhindered. This is especially applicable to screen bypasses, and can also be used for capacitance-coupling to pi-network output circuits. . . . K5JKX/6

RK34's

An excellent bargain in transmitting tubes is the RK34. These are low power dual triodes that make excellent exciters, drivers, multipliers, and finals. The plate dissipation is 10 watts, the maximum plate voltage is in the vicinity of 300 with a maximum plate current of about 80 ma. The full input power can be used up to 250 mc and it doesn't require too much drive. It is the ideal choice for a low power 6 or 2 meter final. The RK34 sometimes known as the VT-224 or 2C34 is available surplus for a few pennies. The probable reason for this is that it is an older type tube. I don't know the exact price that they sell for but I have seen them as low as 25¢ and once I have seen a few of them selling for 10¢. It would be hard to find a better bargain in transmitting tubes than this. . . .WA2INM

Harvey R. Pierce WØOPA
5372 E. Bald Eagle Blvd.
White Bear Lake 10, Minnesota

The Simplescope

Do you have to ask others "How's my modulation?" Do you have to wonder if you are modulating 100%? Do you know how much hum you have? If your speech clipper is clipping? If you have enough drive? If you aren't sure of your phone signals, AM or SSB, build the "Simplescope" and find out!

The name "Simplescope" comes because this is as simple as an oscilloscope circuit can get and still monitor AM, DSB, and SSB signals. I do not claim that this 'scope does a perfect job, or that it cannot be improved. My purpose is to present to you a proven, useable, simple, low-cost oscilloscope monitor. It works as well as many more expensive and more complicated instruments in telling you what your modulation is like, with a minimum of parts and expense.

The total cost shouldn't run over $15.00, but I can't be very definite here, because prices vary so widely from catalogue to catalogue. And what do you have in your junk box? Many of the parts values are not critical, and substitutions can be made if you happen to have a substitute part hanging around. The most important item, perhaps, is the 'scope tube. The model illustrated used a 2AP1A. Latest prices I have for the 2AP1A is $6.99. The 2AP1 will do equally well, and costs only $3.50 from Barry Electronics. The rest of the parts show wide variations in price, too.

The simplification of this oscilloscope monitor lies in the elimination of all non-essential controls and features. This leaves four controls, two passive and two active. The two passive controls are the "Brilliance" and "Focus" controls that can be set once and then rarely touched. The two active controls are the "Function" switch and the "Width" control, that are changed occasionally. There are no vertical or horizontal centering controls because in my experience the undeflected spot of the average 2AP1 or 2AP1A is close enough to the center for average use. Vertical "Height" controls were left out because the ones that worked well were quite complicated. Amplifiers were left out because the sensitivity was more than adequate for the average ham transmitter of 60 watts or more. In fact, the model illustrated was used with great success on a 7½ watt AM transmitter on 10 meters.

This Simplescope is built in a standard 5 x 9½ x 3 chassis with an aluminum plate (not shown) to cover the "bottom" (now the side) of the cabinet. The power transformer is mounted outside at the rear to prevent its magnetic field from deflecting the spot. Don't try to mount it inside. The front end of the 2AP1 is held and framed by an old 2" meter case. Below it on the front panel are the "Function" switch and the "Width" potentiometer. The two knobs on the top rear are the "Brilliance" and "Focus" potentiometers. On the rear, above the power transformer is a terminal board for the audio input and the control circuit, protected by a perforated aluminum cage to prevent careless fingers from touching high-voltage circuits. Above this "cage" is the phono-type jack for the rf input.

Inside, the power supply components are on the bottom and most of the 'scope parts are at the top rear. The pictures do not give any detail here, as the details are obscured by the ten wires from the CRT base. The silicon diodes are mounted on a tie-point strip on the bottom rear. The two 8-mfd, 150-volt electrolytics are between two tie-point strips on the side, and two 1 mfd, 600 volt condensers on the bottom below them. The four bleeder resistors are mounted between them and a tie-point strip on the bottom, center, which also furnishes tie-points for the 117-volt leads for line cord, transformer, and switch. On top, under the handle, the hand-carved U-shaped saddle and aluminum strap that holds the rear of the 2AP1 can be seen. The CRT is wrapped with a strip of felt to protect it.

To save space and cost, no socket was used for the 2AP1. Instead, I used pin clips from two dismantled wafer sockets. Ten are needed. I soldered different colored wires to the lug part of each contact, slipping insulation tubing down over the wire, joint, and lug. These contacts were then pushed onto 2AP1 tube pins, with the lugs inward. Two wraps of ½" wide electrical tape keeps the wires in place and prevents twisting and shorting. Some octal sockets of the molded variety will give pin contacts that can be used with the lug in line with the contact part. Then the insulated sleeve can be pushed down over the tube pin too. While useable, these lugs take up a bit more room. In either case, the contacts and wires are put on CRT before it is installed. After the CRT is put in place, *with*

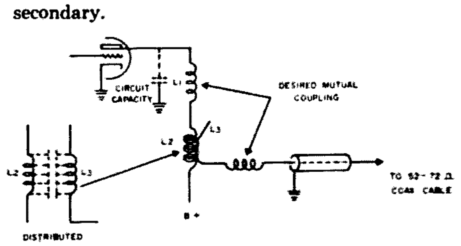
ONLY ONE KNOB TO TUNE THE 200V!

What's behind this knob? The Broadband Principle.

What is meant by a broadband transmitter? It is a transmitter with all stages designed to eliminate the need for manual tuning. Each stage has tuned circuits that are broadly resonant over a predetermined portion of the radio spectrum; for instance, 3.5 MC to 4.5 MC, 13.5 MC to 14.5 MC, etc. The signal is amplified in each broadband stage and is ultimately coupled from the plate of the final RF Amplifier to the antenna feed line through a broadband coupler.

WHAT'S IN A BROADBAND COUPLER? No copper sleeves, ferrites or any other "lossy" elements . . . just wire!

There are no motors, servos or sensing circuits required to keep the 200V tuned up! The design of the broadband coupler does the job for you. It works like a transformer with a primary and secondary.



The primary L_1 L_2 is resonant at the high frequency end of the desired passband. Part of the secondary L_3 L_4 is wound bifilar with part of the primary. The bifilar winding has a distributed capacity between the wires. This capacity appears as a series resonant circuit with L_4 at the low frequency end of the desired passband. By controlling the size of the bifilar winding and the mutual coupling between L_1 and L_4, it is possible to show the amplifier plate an essentially constant load impedance across the desired passband.

Write for 200V brochure for more detailed specifications.

EFFICIENCY? As long as the tube sees the proper plate load impedance, it will deliver power to that circuit. If this impedance is equal to that produced by a normally tuned and loaded circuit and the broadband coupler is not constructed with "lossy" elements, it follows that the RF power will be transferred to the load at essentially equal efficiency.

LOADING? Why do you normally tune and load an RF Amplifier? To make the tuned circuit show the proper load impedance to the plate of the tube at the desired frequency.

The output circuit of the 200V is designed to match 52 to 72 ohm coaxial transmission lines without dipping, loading, or tuning of any kind!

SWR? If the SWR is 2:1 or less, the reflected change in plate load impedance through the broadband coupler will be negligible.

HARMONICS? The broadband coupler could be designed wide enough to pass the 2nd Harmonic generated by the output tubes; however, since this is undesirable, the passband is restricted to one megacycle and a series trap circuit built-in to reduce 2nd and higher order Harmonics better than −50 db. The Harmonic rejection of the broadband coupler is equal to or better than a properly tuned Pi network.

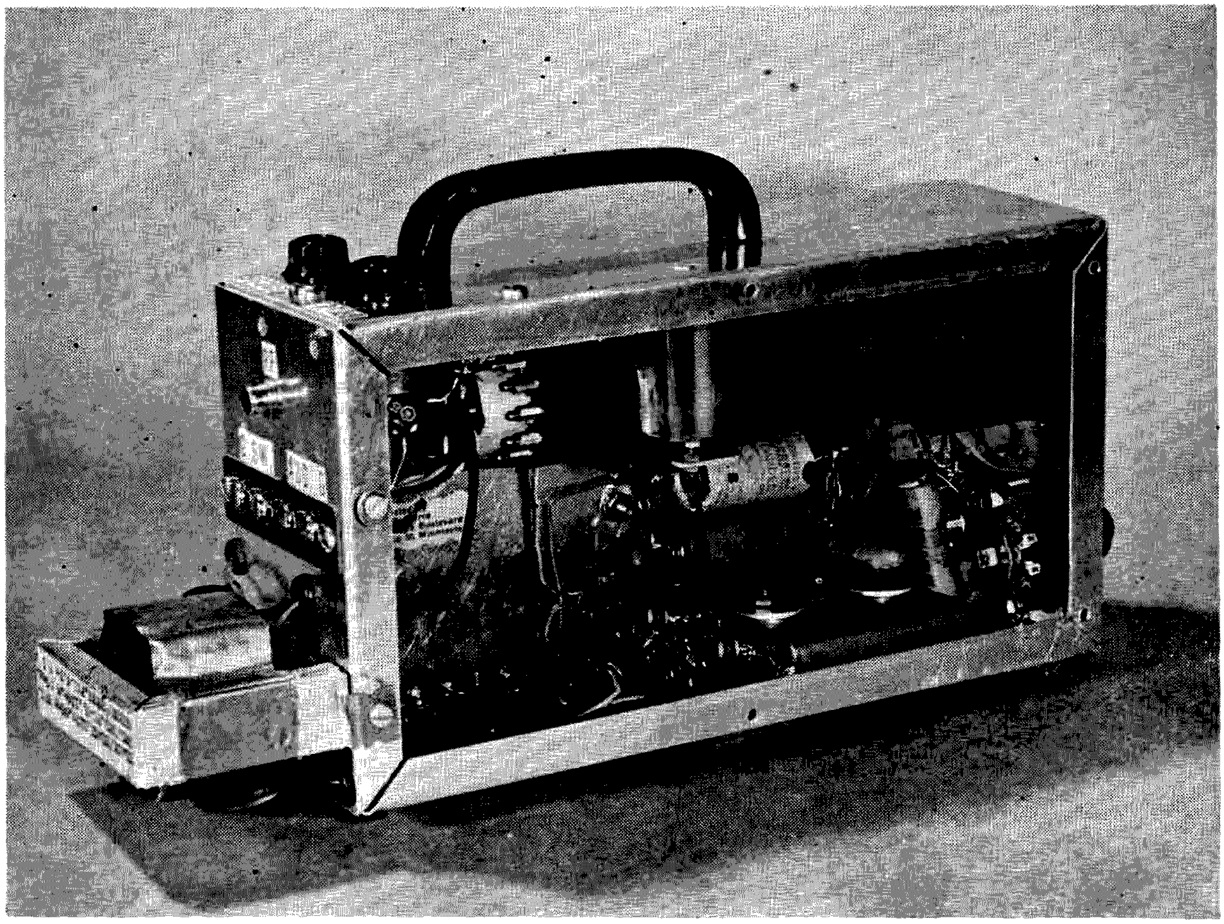
The overall broadband circuit design makes possible a true single knob controlled transmitter. The *ONLY* tuning control is the VFO. In fact, the hands are so arranged that if you have the VFO set to 7280 KC and band switch to 20 meters, the transmitter is instantly ready to operate on 14280 KC; or switch it to 15 meters, and you are instantly on 21280 KC. The 200V is a Band Hopper's dream transmitter. It is the only transmitter that tunes like a receiver and yet provides the best sounding signal on the amateur bands!

73 Wes

Wes Schum, W9DYV

Central Electronics, Incorporated

A subsidiary of Zenith Radio Corporation **1247 W. BELMONT AVENUE CHICAGO 13, ILLINOIS**



the key of the locating pin on the bottom, the wires are cut to the proper lengths and soldered. Enough slack should be left in these wires to allow the 2AP1 CRT to be rotated 15 degrees either way to "level" the pattern later. While there are 10 wires coming from the CRT, only 7 colors are needed because pins 3, 7, and 9 are all ground and can be the same color, and pins 1 and 2 are connected together and can be the same color. Incidentally a likely source of both pin contacts and colored leads, already soldered, is a used TV picture-tube socket. Get a couple from your TV serviceman. Be sure to keep a record of the CRT pin numbers and colors, just in case. Write them on the inside of the side cover, where they won't get lost. This is also a good place to paste a schematic of the Simplescope, too.

Looking at the schematic diagram, Fig. 1, shows the rf input going direct to pin 6 of the 2AP1, with a 2½ mh rf choke furnishing a dc and low-frequency ground. Vertical height is determined by the coupling to the transmitter. Various methods of coupling will be discussed under installation.

The horizontal circuit consists of a .01 mfd blocking capacitor and the 1 megohm "Width" control. The "Function" switch connects this to the "AUD" terminal for a trapezoid type pattern or to one side of the 117-volt line for the "envelope" type. More resistance must be added between the "AUD" terminal and the modulated voltage in the transmitter in a ratio of one megohm, 1 w., added for every 200 volts in excess of 250 volts. The voltage rating of the blocking capacitor should be twice the dc voltage.

The function switch is a two-pole three-position wafer switch. It turns the power on to the Simplescope, and changes the pattern from the "Envelope" type with 60 cycle sweep to the "Trapezoid" type of display. This switch must be of the smaller size wafer to fit in the space allotted, but otherwise it is not particularly critical as to make or rating.

All three potentiometers shown should best be of the medium size, and have a linear taper, but here again there can be variations. If you have a pot of the right size, use it regardless of taper. And it won't make much difference if the value is up to 25% off. As to size, use them if they fit the space available. Because the "Brilliance" and the "Focus" pots operate at fairly high voltages above ground, they should preferably be mounted on an insulating board, and not the chassis, and their knobs should have recessed set screws.

All fixed resistors are one watt carbon. The .01 capacitor from pin #10 of the scope to ground is part of the power supply filter, in effect, and keeps stray voltages from intensity modulating the trace. It could be made a larger value, if you happen to have one, but for convenience in size a .01 mfd 1 k volt disc ceramic

is best.

The power supply is a full wave voltage quadrupler and uses a small and inexpensive transformer ($1.35 from Olson) and silicon diodes rated at 150 v RMS. These diodes range in price from 49¢ to $3.75 each. Current ratings are not very important here as the current drain is low, only a few mils. The voltage ratings should be *at least* 150 volts RMS for the 130 volt transformer, higher voltage ratings are OK if you want. Selenium rectifiers can also be used, but they take up a lot more space, are harder to mount and give less output voltage. The capacitor values given are a compromise between various factors of size, cost, and availability. The builder can use higher values of both capacity and voltage here if he wants, if the capacitors will fit the space. The 47 ohm resistor in one lead of the transformer is the usual surge-limiting resistor to prevent damage to the diodes from the charging current into the capacitors. It can be increased in value to 100 or 150 ohms without harm. The four 470 K ohm resistors form the bleeder, and here, too, some variation can be allowed, but lower values reduce the output voltage, and higher values slow down the discharge rate.

With the values given for this quadrupler supply, the output voltage is 600 volts, plenty for the 2AP1 CRT tube which will work on as little as 300 volts. Lower voltages give greater deflection sensitivity but less margin in brilliance. With lower voltages the scope is much more susceptible to stray magnetic fields from adjacent power transformers and chokes, audio output transformers, etc.

The high voltage to the scope is turned on and off by a switch or relay contacts connected to "SW" and "G." This system was chosen over the "Blanking voltage" system because one of the leads is ground and as a result any accidental short circuit of these leads to each other or to ground, can do nothing more than turn on the scope spot or trace. The Simplescope should be turned on and off with the transmitter, otherwise the undeflected spot will soon burn a dark spot in the screen, or a dark line if the 60-cycle sweep is used. For temporary testing purposes the two terminals may be connected together without harm, of course. If a relay, either ac or dc is used to turn the high voltage on and off simultaneously with the transmitter, it should ***never, never*** be mounted in, on, or near the scope since the magnetic field of its coil will distort the pattern on the Simplescope.

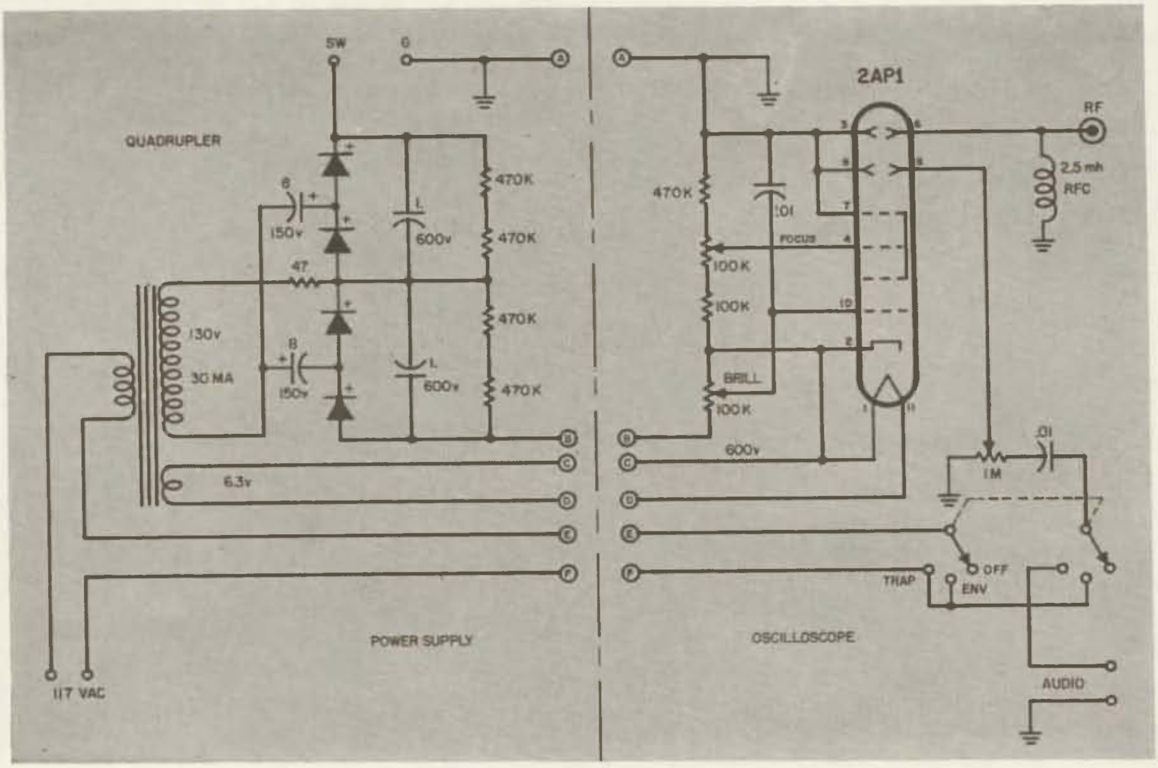


Fig. 1

Fig. 2 shows two alternative power supply circuits that can be used to fit different power transformers that the builder may have in his junk box. Fig. 2A is a doubler circuit, suitable for transformers with a high voltage secondary of 225 to 300 volts. Be sure the rectifiers used will stand the transformer voltage. Fig. 2B is a half-wave circuit for transformers with a high voltage secondary giving from 500 to 750 volts. While the 5Y3 voltages ratings are exceeded, the current is very low, and the tube gives no trouble. There is plenty of room to mount it horizontally inside the chassis. Transformers less than three inches wide for mounting on the rear of the chassis

can be had for both the above circuits, but if yours is too big, it could be mounted separately, at the cost of reduced mobility, compactness, and utility of the scope.

In using junk box transformers be sure that the high voltage centertap is *not* internally grounded. (It is in a few types I have run across.) *Please note that in none of these power supplies is the negative grounded.* This is *one* case in which neither the negative high voltage, the cathode nor the heater circuit is connected to a ground. For simplicity and safety in the input and deflection circuits the *positive* end of the high voltage is the ground.

The same circuit and parts values shown in Fig. 1 may be used with the 3AP1 or 3BP1 scope tubes provided higher voltage power supplies are used. About 900 to 1000 volts are needed with these tubes. Of course a larger cabinet is needed, and the pin numbers will be different.

In figuring dc voltages from your power supply add 20% to the RMS ac rating of the high voltage winding and multiply by 4 for the quadrupler circuit or 2 for the doubler circuit. The half-wave circuit will give more than a 20% increase.

If you don't have an old 2-inch meter case to hold and frame the face of your CRT tube, there are other methods that can be used.

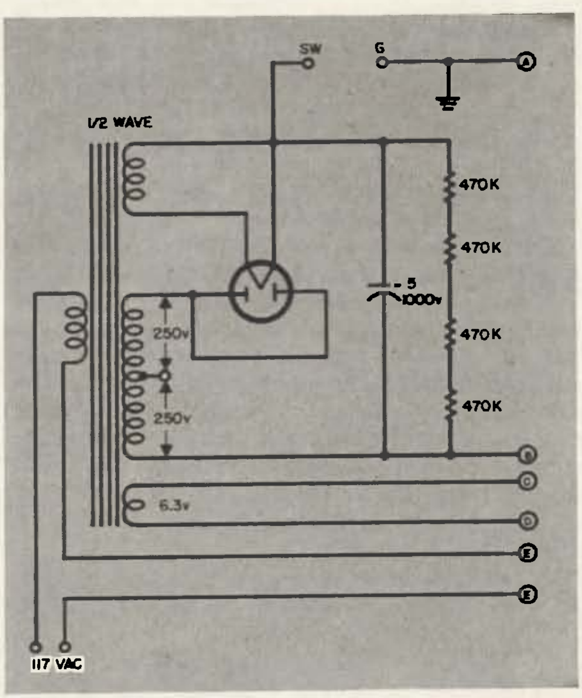


Fig. 2B

Probably the simplest is to make a grommet by slitting a length of rubber or plastic tubing of about ¼" diameter and putting it around the opening. Or leaving the edge of the hole bare and supporting the end of the tube by three or four small rubber grommets bolted to the panel around the hole on the inside. A frozen orange juice can is a loose fit for the end of the CRT. With both ends cut out, and

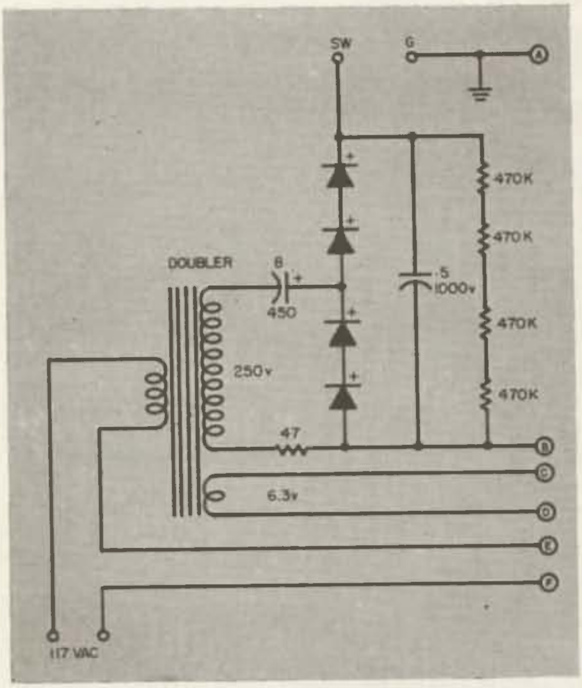


Fig. 2A

painted black, this makes an excellent light shield when slipped over the tube.

If an old 2-inch meter case is used, the glass is discarded and in most cases the support for the zero adjusting screw must be cut out to make the face opening round. Cutting this out is best accomplished with a coping saw using a metal-cutting or jewelers blade, and rounding the edges with medium or fine emery cloth. Clear nailpolish will shine the sanded surface beautifully.

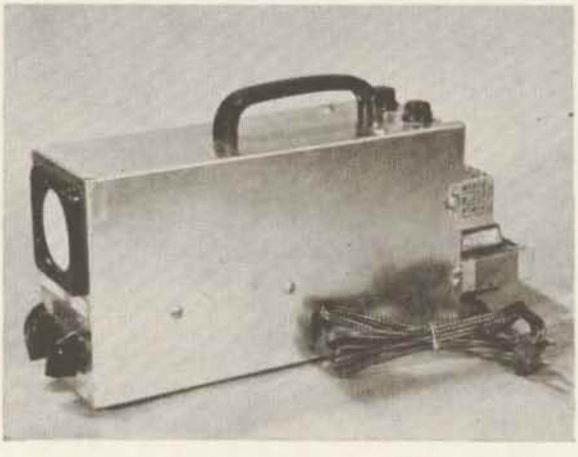
In building and wiring the Simplescope there are few critical points. In the power supply polarity of the diodes and the capacitors must be carefully checked. Because no grounds are used in the rectifier-filter-bleeder circuit, be careful all parts are well insulated from ground. In the scope circuit, outside of the same insulation precautions, the only important thing is to keep the rf lead to pin #6 short and as far away as possible from everything else. All the other wires can run as convenient. And I might repeat again here that the builder should color-code the leads from the CRT tube and keep a record of them for future reference.

Testing is simple. With "SW" to "G" connections open, plug it in and turn it on. See if the CRT tube lights by looking for a glow in the base. OK? Now turn it off and hook a voltmeter from positive to negative. Any voltmeter that reads 1000 volts at more than 1000 ohms per volt will do. Turn on the power. Voltage OK? Turn off the power and connect "SW" to "G" temporarily, set the "Focus" control half on, and turn the power on and the function switch to the "Trapezoid" position. Adjust the "Brilliance" pot until a spot appears, then adjust the "Focus" control for the finest spot. Readjust the brilliance if the spot is surrounded by a halo. Turn the function switch to the "Envelope" position and advance the width control. The spot should turn into a horizontal line. If the line can't be made long enough to go beyond the edges of the tube face, try reversing the ac plug in the socket, or ground the scope case, or both. If the line isn't exactly horizontal, loosen the CRT clamp and rotate the tube until it is. The brilliance and focus controls can now be touched up to get the best results. Failure to get proper results at any point of the above test should pin-point the trouble for you. If you have to check for voltages at any time, don't forget that the case is *positive*.

The undeflected spot should be fine and round. If it is a line, or "S" or "O" shaped there is some stray ac field that is affecting it. Pull the ac plug while observing the spot, and if it changes shape at the instant the plug is pulled, it is the scope transformer's field causing the trouble. The cure is to position the transformer differently. Sometimes a copper shorting band as shown in the picture will help. I put this band around this transformer while working on the problem of putting the transformer inside the case. It did help, but not enough. In the position shown for this type of transformer, the band was not needed, but was left on to protect the windings.

If the spot is not close enough to the center of the CRT tube face to suit you, and you are of an experimental nature, try putting a small (1" x ¼" x ¼") magnet different places around the cabinet. You'll probably find a place where the spot will center and the pattern won't distort.

Now that you have the scope built and tested, the next step is to install and use it. There are four different connections to be made for proper operation, but first you must find a place to put it. The Simplescope is small, requires little desk room, and all the wires come out the back, but you must bear in mind that the electron beam of the tube is very susceptible to magnetic fields, so it shouldn't be put anywhere in the field of a transformer, even an output or modulation



transformer. In general, this means six inches distance. Don't depend on a cabinet to "shield" the transformer, either. You may have to experiment a bit to see where it will work best. Turn the Simplescope on, get a fine spot on the face of the tube, and move the scope around, seeing where you can put it where, (A) you can see the tube face clearly without glare, and (B) where the spot is not moved by either 60 cycle or audio fields from transmitter or receiver.

The first connection to be considered is the power line. This 117 v. 60 cycle power should preferably come from the primary of the filament transformer of your transmitter. This connection assures you that the Simplescope will only be "on" when the transmitter is on. Other sources can be used, but at the risk of having the Simplescope left on accidently, because it gives no light or sound to indicate the switch is on and the high voltage and heater active. Of course, if you habitually use a "Main Switch" that turns off everything in the station, it is OK to use such a controlled 117 v. outlet.

The second most important connection is the rf pickup. The simplest method is to connect an antenna to the rf jack thru a variable capacity of some sort. The antenna length and position and the amount of series capacity will control the vertical height, which should be about one inch. The best method is to run a short piece of RG58 or 59/U from the rf jack into the transmitter and couple it through a small capacitor to the antenna coax. The value of the coupling capacitor will depend on several factors, but in general the higher the transmitter power and the shorter the coax from the scope, the smaller the capacity that will be needed to produce a satisfactory pattern on the CRT face. With very low powers, a direct connection can be made. An advantage of this method is that if the transmitter output is into a very low SWR line on all bands, the scope pattern will be the same on all bands. Various other pickup methods for getting rf may also be used, such as from antenna tuners, etc. The point is to feed enough rf in to get a readable pattern.

The third connection is the control line "SW" and "G," the terminals that must be connected together at the same time that plate voltage is applied to the transmitter. They may be connected together by extra contacts on the send/receive switch, antenna relay or plate relay, or as mentioned previously by a separate relay activated by the send/receive switch.

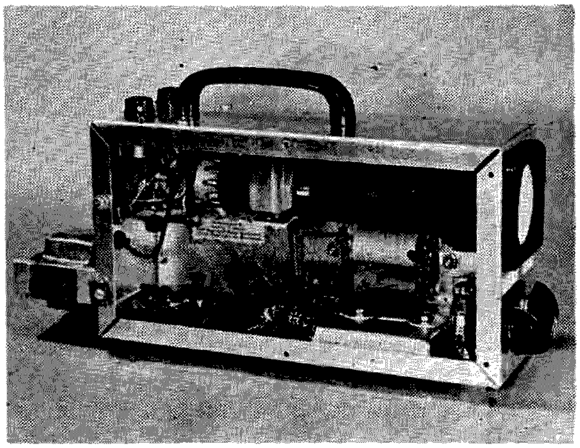
The last connection to be made is for the audio. The "AUD" terminal is connected to the actual modulation voltage in the transmitter. It must NOT be connected to the speech amplifier, driver, modulator plates or primary of a modulation transformer. Any connections but to the actual modulated voltage will give a false picture because it will

not contain all the phase shifts and distortions that may occur in the modulator. Thus the proper connection to a plate-modulator transmitter is to the terminal of the modulation transformer that connects to the rf plate circuit. For clamp- or screen-modulated transmitters (such as the DX40) the connection is to the screen terminal of the modulated tube. For DSB and SSB transmitters. The connection is to one terminal of the modulating voltage system. In this case the Simplescope may not be satisfactory because some DSB and SSB modulating systems operate at such a low level that there isn't enough audio voltage to give a satisfactory deflection horizontally. For the Simplescope illustrated it takes about 25 volts RMS or 70 volts peak-to-ptak to produce a usable horizontal sweep (about ½ inch). Where the dc voltage being modulated is over 250 volts, additional resistance should be added in series with the "AUD" lead as previously mentioned, and this resistance is preferably installed in the transmitter to reduce the hazards of bringing the full voltage out of the transmitter. If more than one megohm is needed, use a series of 1 meg. one watt carbon resistors instead of a single larger value, to prevent possible arcing troubles. In cases where the modulation transformer terminals are available without digging inside the transmitter (the B&W 5100B, for one) these added resistors can be enclosed in a length of insulating tubing, or very thoroughly taped with a *good* electric tape for protection, and placed outside the transmitter. The "AUD" connection on the Simplescope can be made a high-voltage terminal and the resistors placed inside the case. Don't forget to ground the scope to the transmitter.

Of course the Simplescope can be used "as is" for temporary modulation checks with *no* connections to the transmitter, just using the "envelope" type of pattern to check modulation percentage, but this type of check doesn't tell all the story. For a temporary check it is only necessary to connect the "SW" terminal to "G" as when the Simplescope was tested, put the "Function" switch in the "Envelope" position and feed enough rf into the rf jack (from an antenna or pickup wire) to make the vertical height about ¾ inch, and advance the width control until the envelope is the full width of the CRT face.

The unmodulated envelope pattern is a green ribbon, with top and bottom edges straight and parallel. When the carrier is modulated, ripples occur on these edges, the size of the ripples and waves depending on the modulation percentage. A wave on the top edge will be a mirror image of the wave on the bottom edge. "Perfect" 100% modulation occurs when the outer extremities of these waves double the width of the unmodulated ribbon or envelope, while the inner extremities just meet in the middle, making a bright dot. Over modulation is easily detected as the dots turn into dashes. Clipping and limiting can be detected as a flattening of the peaks of these waves at a certain width of the pattern. Frequency response can be roughly judged by the proportion of high and low frequency waves under average modulation. Close observation is necessary for any wave-form distortion with the Simplescope because of the 60-cycle sine-wave sweep, but major troubles can usually be detected. Hum and noise show up well in the envelope pattern. Hum is seen as humps, dips, or loops in the top and bottom edges of the pattern. Two humps and two dips or two loops show 120 cycle hum, and a single loop or non-parallel edges show 60 cycle hum. Noise shows as irregular spikes or ripples.

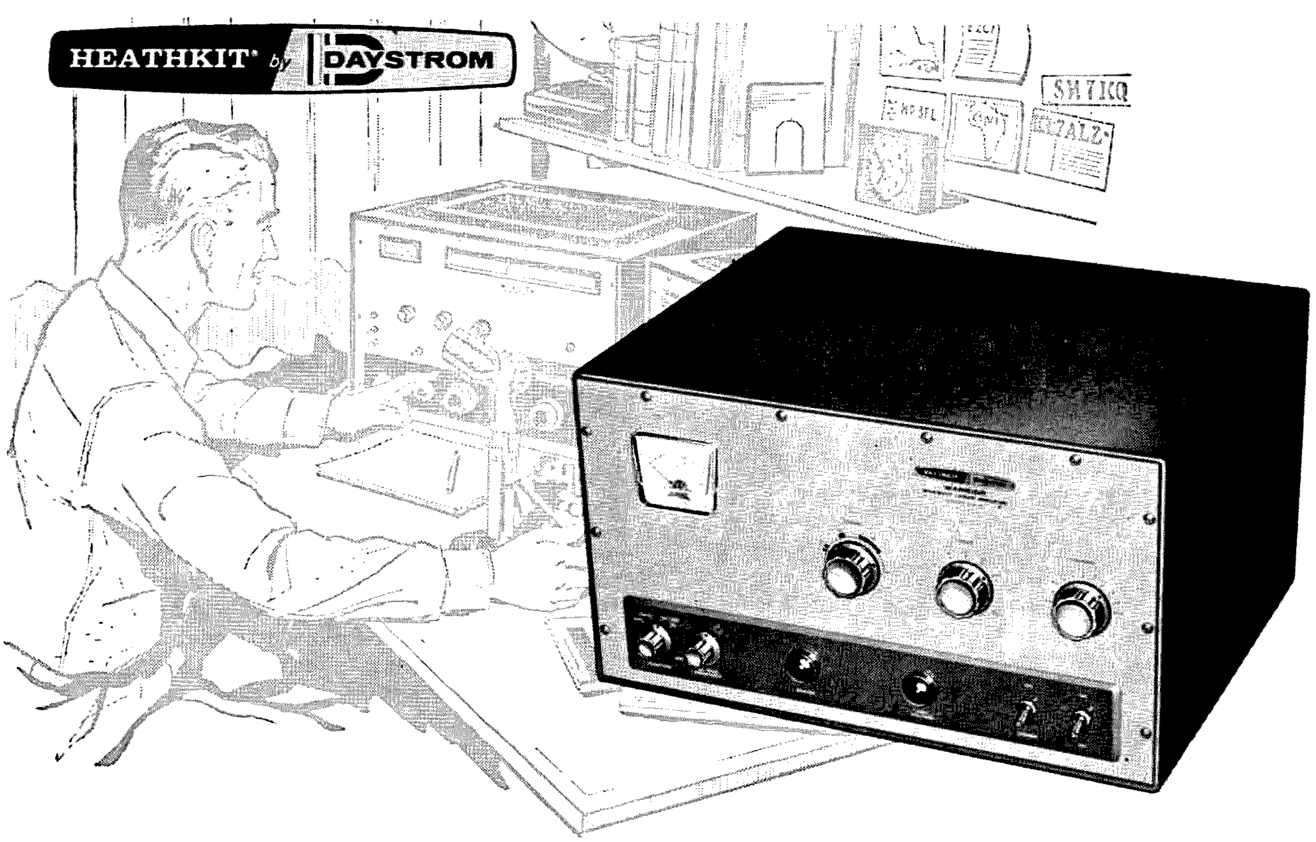
The trapezoid pattern shows the unmodulated carrier as a vertical line that widens with modulation into a trapezoid. At 100% modulation the trapezoid becomes a triangle, and over-modulation is indicated by a line extending from the point of the triangle. The upper and lower edges should be perfectly straight. Any curvature indicates non-linear modulation of the carrier. The commonness cause is low excitation, or too heavy loading, or



both. Poor design of the final is also a possibility. In efficiency-modulated finals (Grid, screen, cathode, or suppressor modulated) the correct adjustment shows up as the best-looking trapezoid.

In the trapezoid position SSB signals show as the "Bow-Tie" pattern. See the side-band handbooks and articles for interpretation. It is beyond the scope of this article to give instructions for interpreting scope patterns beyond the most common and simple effects. The Simplescope will monitor your modulation, hum, and excitation constantly and accurately. When you use it you'll never have to ask anybody, "How's my modulation?" Or, "Have I got any hum?" You'll know!

In conclusion I want to thank Bob Rode, WøBRE, for taking the excellent photographs as well as many useful suggestions for the design, and to Jim Borders, KøKMD, for building the preliminary model. Jim's worked the first time he plugged it in, and I hope yours does, too! Have Fun! . . . WøOPA



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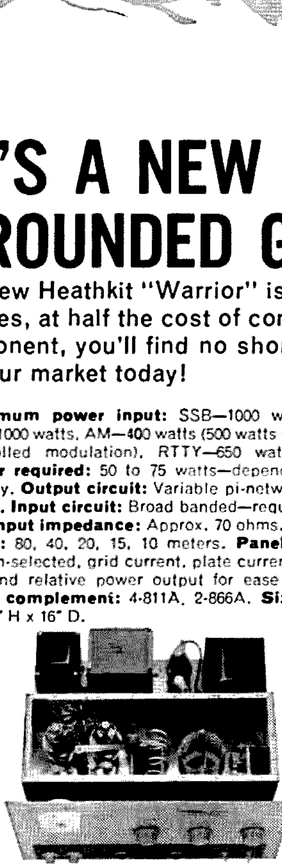

This inside view shows the neat circuit layout and husky components that emphasize quality. Note the internal shielding of plate circuit for maximum protection against TVI.

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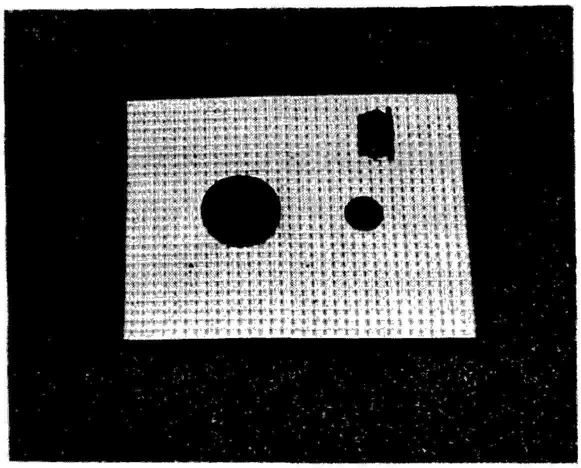

Photo Credit: Morgan S. Gassman Jr.

Snap Bushings Customize Equipment

Roy E. Pafenberg

THE appearance deficiencies of ventilation and clearance holes drilled in thin sheet aluminum are recognized and compounded if pre-finished enclosures are used. John Howard, K8MME, in a September, 1960 QST article, "Aluminum Eyelets Make Good Fever Medicine," proposes an answer to the problem. The solution is very effective, however there is work involved and the eyelets must be backed up for peening.

The use of plastic snap-in bushings came to mind and information was requested from the Heyman Manufacturing Company of Kenilworth, New Jersey on their line of HEYCO nylon bushings. The literature received by return mail provided the answer to this and other perplexities that plague the amateur constructor who attempts to achieve commercial appearance with hand tools.

As shown in the photograph, these HEYCO bushings are made of black nylon and will firmly lock into any chassis or panel up to ⅛" thick. They are available to fit clearance holes from ⅜" to 2", with inside diameters ranging from $\frac{3}{16}$" to 1⅝". These bushings are ideal replacements for the conventional rubber grommet and the smaller sizes will provide painless eyewash for cabinet ventilation holes.

Advantage may be taken of the excellent bearing surface characteristics of nylon by using these bushings to ease the friction in the mechanical assemblies necessary in high power transmitter construction. For example, the SB-375-4 bushing snaps into a ⅜" clearance hole and provides a ¼" bearing surface. These dimensions make them ideal for use as component control shaft feed-thru bushings. Being somewhat flexible, they are less critical of alignment than are the conventional metal panel bushings and friction is reduced.

For filling unusued panel holes, the same style bushing is made with a smooth finished, closed top and sold as a hole plug. Aside from affording a welcome change from the usual chrome plated version, these provide an excellent means for the insulated mounting of a variety of components. The thin but strong nylon top is readily drilled to accommodate a jack or other part. Don't be concerned about the plugs pulling out. Though they are installed with finger pressure and are just as easily removable, the manufacturer claims they will withstand a 35 pound pull.

With all the advantages cited, there must be one fly in the ointment. These bushings and plugs are apparently available only through the manufacturer in minimum quantities of 100 each. Aside from the inconvenience of mail order buying, this is no real problem since the prices are low enough to make purchase in 100 lots attractive. For example, the smaller size bushing shown in the photograph sells at $1.90 a hundred, less 1% on cash transactions. A letter to the company will bring catalog sheets and from that point you are on your own.

VFO Chirp vs. 6AU6

Al Brogdon, W4UWA/K3KMO
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FOR some odd reason which has never been satisfactorily explained to me, several commercial equipment manufacturers have chosen the 6AU6 as a VFO tube. From my own experiences, and those of quite a few other hams, the 6AU6 is a mighty poor choice for this service. The case histories of two popular pieces of ham gear I have owned tell the story:

A number of years ago I bought a Heathkit VF-1 VFO. After building the thing with extreme care in order to produce a stable unit, I was disappointed to learn it chirped like mad when I keyed it for break-in CW. The 6AU6 tested OK, and all other parts of the VFO seemed fine. On a hunch, I tried plugging in another 6AU6. All of a sudden—the chirp was gone! And still a third 6AU6 produced the chirp again. Obviously there is some feature of the 6AU6 such that, although it may

test red hot on a tube checker, it may still chirp. And as long as I owned that VFO, the thing would key beautifully for break-in CW —the *only* way to work CW.

Recently, I bought and assembled a Viking Navigator. As most of you know, this transmitter and others in the Viking line feature grid-block time-sequence keying. The operation is simply this: When the key is closed, the keyer tube allows the VFO to start and go through any chirp inherent in the VFO circuit, then after the frequency is stabilized (a matter of a few milliseconds), the keyer tube turns on the buffer. Thus, the VFO may chirp, but it will do so at a time when the signal is not on the air. Well, when I started keying my Navigator, a V sounded like "yoop yoop yooooooooop." Oh Lord here we go again. What was happening was that the 6AU6 was chirping over such a long time period that it was *still* settling down when the buffer came on.

Sure enough, it turned out to be the 6AU6. Another brand new tube that tested "jes fine" on a tube tester, but chirped away. So instead of plugging in another 6AU6 and taking the chance on it going soft and having to soon be replaced, I decided this is the time to try a more permanent cure. Besides, I was losing patience with those 6AU6's.

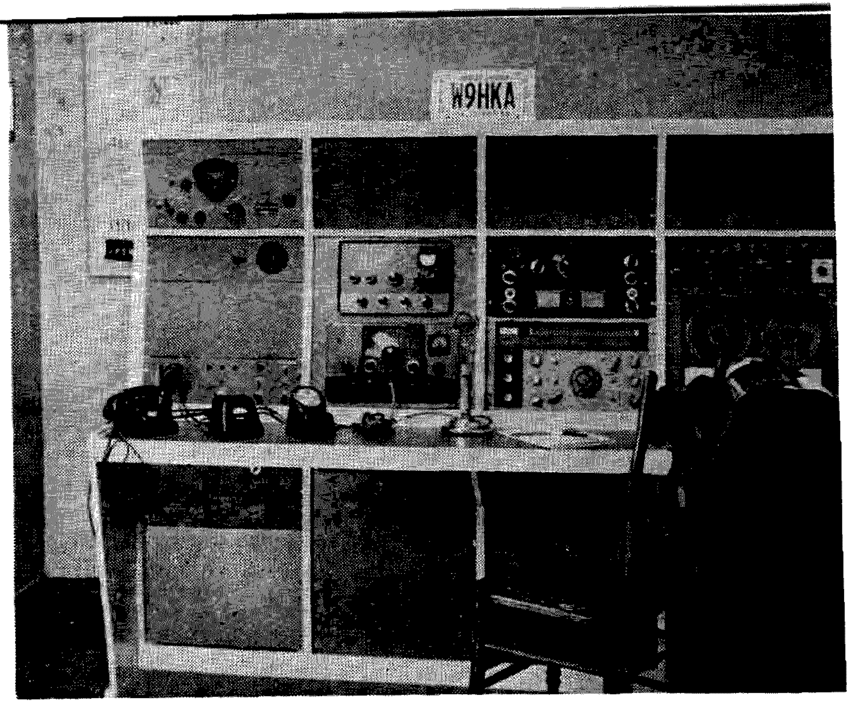
To state it simply, I checked the tube manuals and found that I could interchange a 6AH6 with the 6AU6, and plug it right into the VFO tube socket without making any wiring changes. Since I have been using the 6AH6, the Navigator has functioned perfectly with no chirp.

In the course of many CW contacts, I have run into several other fellows that have had the same chirp trouble with their VFO's, especially when cathode keying the Heath VF-1, with no time-sequence keying to take up the slop. A couple of these fellows have tried switching tubes and using 6AH6's with the same results I did. Now don't get the idea that switching to a 6AH6 will cure all your VFO chirp—please understand that this only applies to cases where the 6AU6 itself is the cause of the chirp. You may have chirp originating in any of a number of other sources in the VFO. Simply changing tubes won't cure all these sources.

But if you have a Clapp VFO circuit, such as the VF-1, the DX-100 VFO, Viking (Ranger, Navigator, etc.) VFO, or a homespun job, using a 6AU6—it's worth the try to get rid of an annoying chirp by plugging in a 6AH6 to see what happens.

As a closing note, calibration should be checked after switching tubes. The calibration will usually shift just a little bit due to the change from the 6AU6 to a 6AH6, and if you chase DX near the band edges, always play safe.

W4UWA/K3KMO



Beryl Dassow W9HKA
Clifton, Illinois

Console

DURING some period of a radio amateur's life there comes a time when he becomes conscious of the fact that the operating position leaves quite a bit to be desired. That is from the standpoint of orderliness, ease of operation and flexibility. Therefore, as can be seen in the photographs, an operating console was constructed.

The use of the standard relay rack panel spacing of 19 inches was used to provide the required orderliness. The grouping of the various pieces of gear as to the most active area on the console, gives us the ease of operation. The use of tempered hardboard cut to rack and panel size (or larger as in the case of the second photo), gives us the needed flexibility. Flexibility in that it makes it much easier to use either regular relay rack panel mounted equipment or the cabinet type as shown in both photos.

The unit as shown in the present dimensions may be a trifle large for the average amateur's allotted space. However it can be readily pared down to a three-panel width without adverse effects as to the overall usefulness.

This type of relay rack panel mounting was chosen over that of the semi-circular console design because of the simpler method of construction.

The entire rack may be constructed with hand tools with the exception of the vertical dividing and mounting pieces. For a four-panel width as shown, a total of five pieces, each about 5½ feet in length is necessary. These can be usually cut at the lumber yard from a 2 by 3 or 2 by 6 fir stock at the time of purchase. See Photo 5 and Figures 3A and 3B.

Note also there are no special joints required. Since butt joints are used in most cases the unsightly joints are quite noticeable. To overcome this problem quite effectively, flexible wood trim tape is used. The type used is made by Weldwood in 8 foot lengths and the width varies from one inch to 1½ inches across the desk top front.

The desk top is covered with a piece of vinyl material. The material as shown was fastened with a pressure-sensitive adhesive and a great deal of care must be exercised when cementing the vinyl to the plywood desk top. The usual procedure is to place a newspaper between the two cemented pieces and gradually remove same as the vinyl is carefully rolled into position. To trim the vinyl edges, a beading strip is tacked into place. The wood tape as mentioned earlier will cover the front edge of the vinyl.

You will notice upon adding the various widths of wood strips and panel areas, an allowance of an extra half inch. This is to give a final 1/8 of inch spacing on either side of each panel when mounted. The vertical spacing is sufficiently oversize as well.

Photograph number one shows the original console construction. However after the author traded equipment it was then necessary to make additional room for the newly acquired Valiant which is "over-size." This is easily ac-

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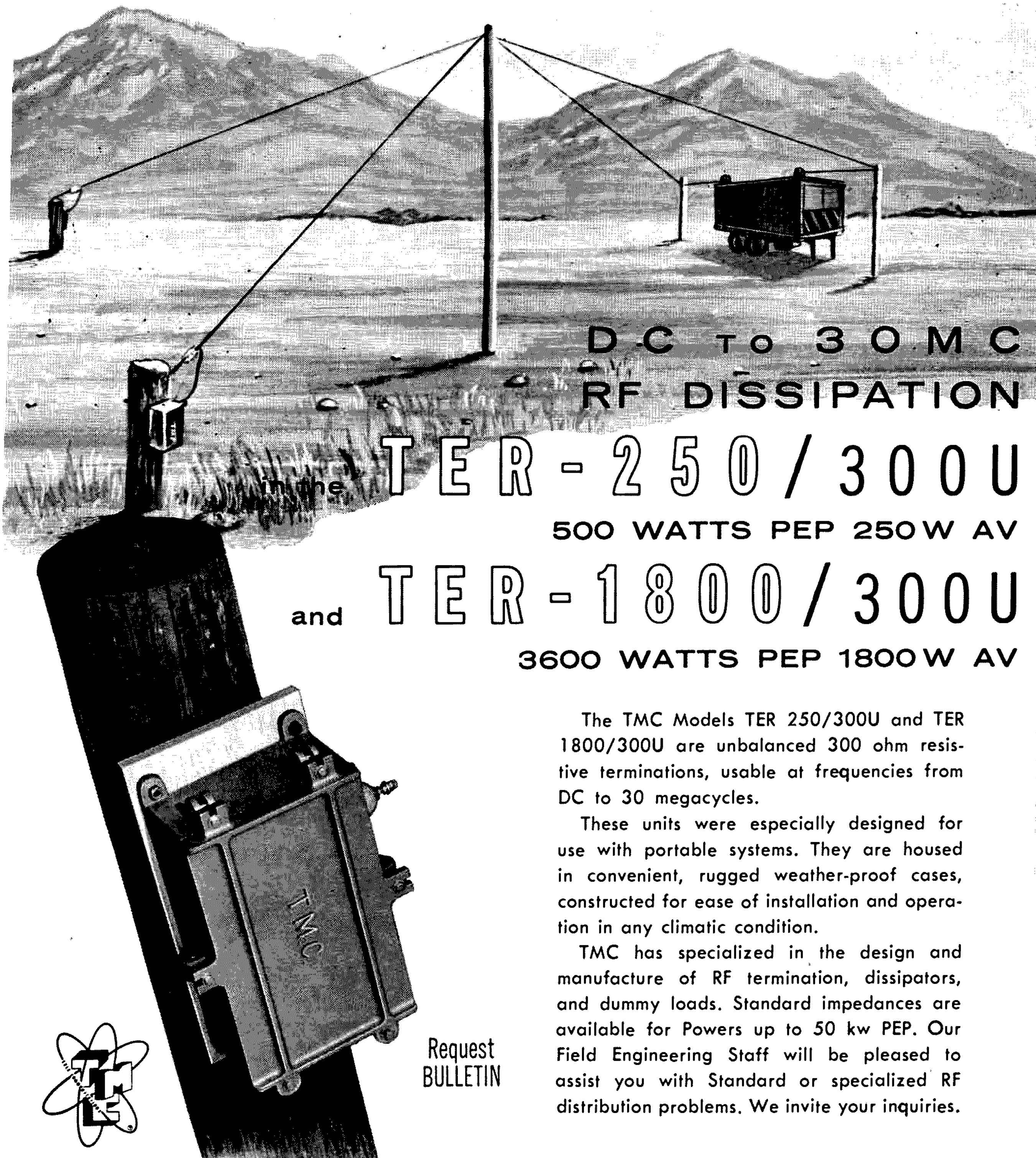

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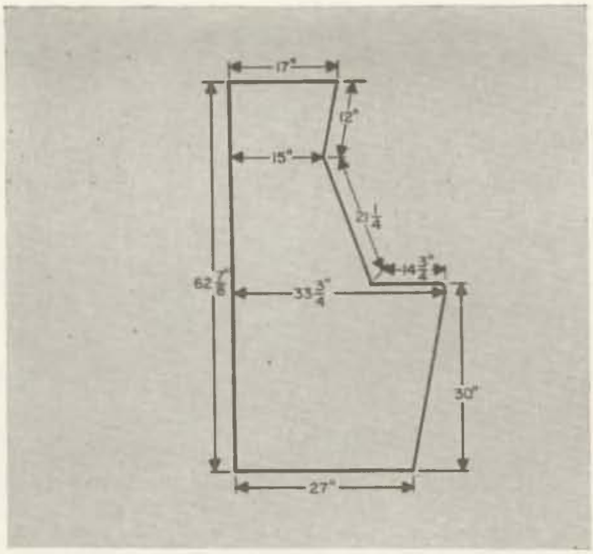

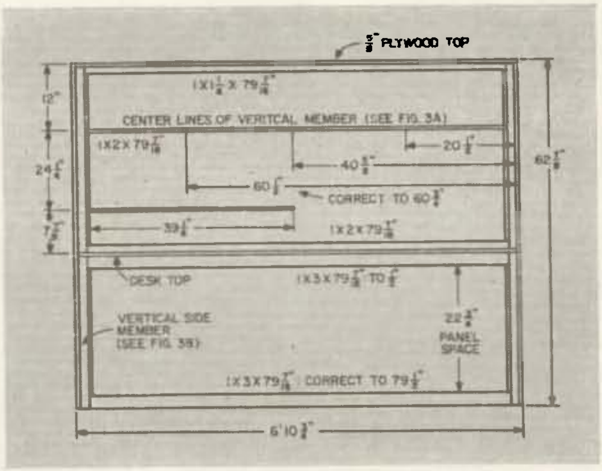

Fig. 2

← Fig. 1

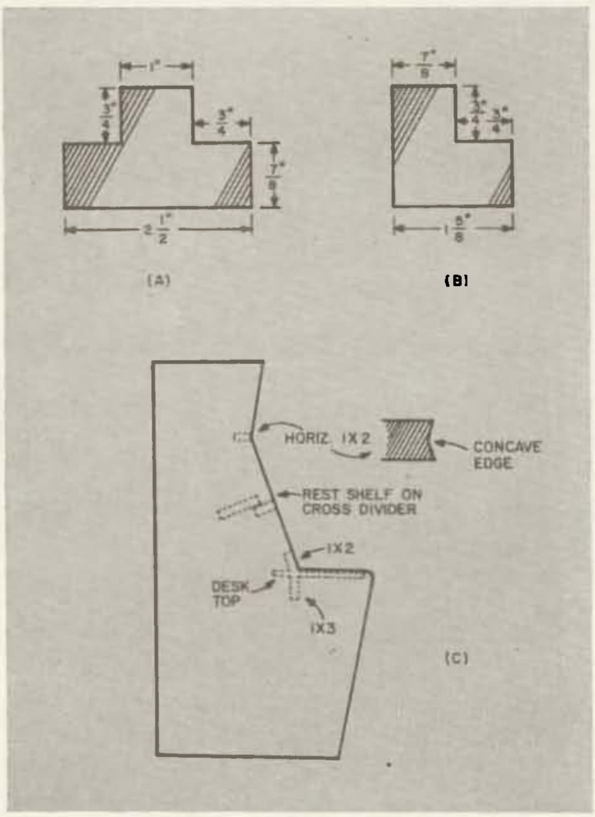

Fig. 3

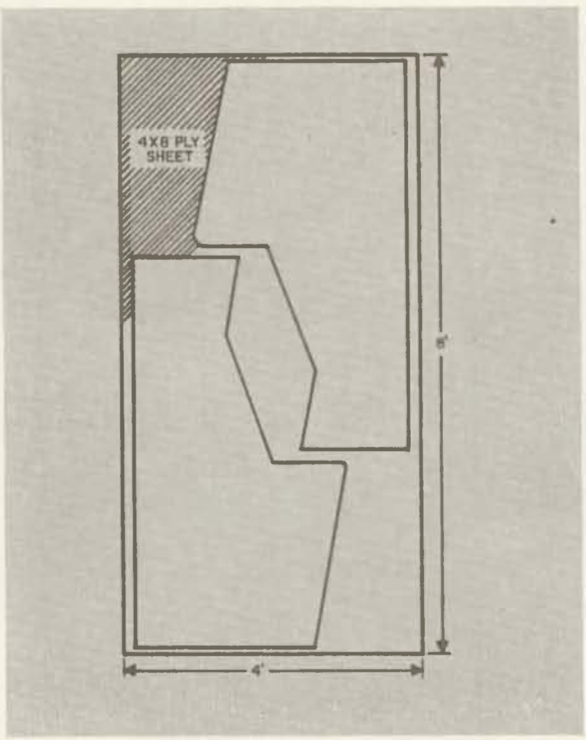

Fig 4

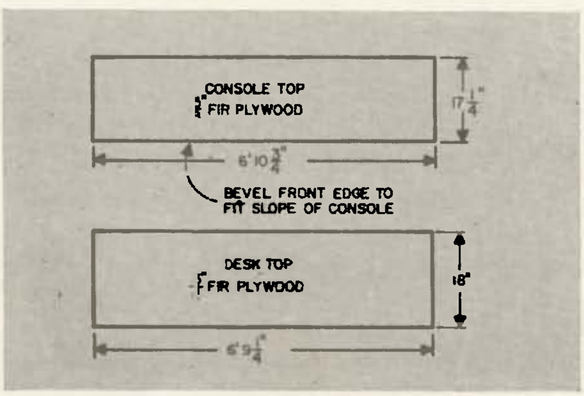

Fig. 5

complished by the removal of a vertical member. Note in Photo 4 the addition of a brace for added strenthening when this vertical piece is removed. Also added as per Photo 2, is a horizontal 1 by 2 for dividing the new panel across the bottom. This then leaves a space of 13¼ by 39¼ inches for use by the 6N2 and the Valiant. Other arrangements can be made to suit each individual station depending on the gear to be mounted.

As far as the mounting of the cabinet-type equipment, it is necessary to construct a simple shelf from the plywood left in the cutting of the sides or ends. It is best to run a vertical brace from the rear of this shelf down to the 2 by 4 tie at the bottom of the console. Note this 2 by 4 in Photo 3 across the bottom back

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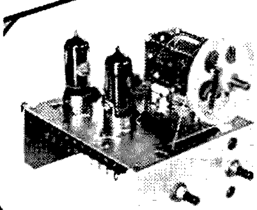

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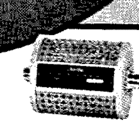

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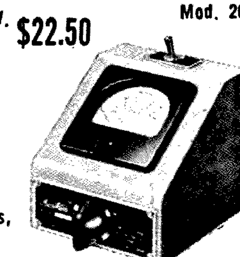

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Mod. 262 INDICATOR
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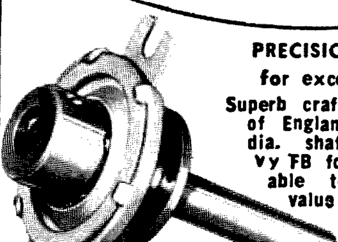

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Superb craftsmanship by Jackson Bros. of England. Ball bearing drive, 1/4" dia. shaft, 1 1/8" long, 6:1 ratio, vy FB for fine tuning. Easily adaptable to any shaft. Comparable value — $5.95.

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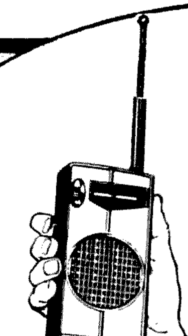

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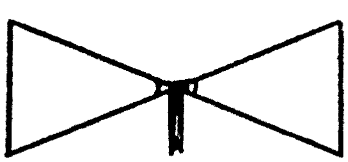

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As featured in Nov. 1956 QST. Complete with B & W 3013 Miniductor. Only 8 ft. long for 10 meters. Wt. 5 lbs.

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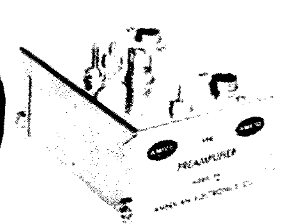

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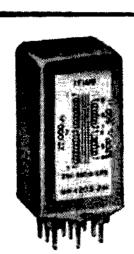

Same as used in W2EWL SSB Rig — March 1956 QST. Three sets of CT windings for a combination of impedances: 600 ohms, 5200 ohms, 22000 ohms. (By using center-taps the impedances are quartered.) The ideal transformer for a SSB transmitter. Other uses: interstage, transistor, high impedance choke, line to grid or plate, etc. Size only 2" h. x 3/4" w. x 3/4" d. New and fully shielded.

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SAY! YOU SAW IT IN 73

of the console. When cutting the hardboard to fit the cabinets, cut the round portions (corners) somewhat undersize and then file with a half-round file to fit. The straight edges can be cut with a coping saw as one will be working near enough to all four of the edges. The above may sound tedious but the hardboard saws and files very easily and the result gives a fair fit.

If one is careful in laying out the sides, one sheet of ¾ inch thick fir plywood in the 4 by 8 foot size will suffice. The plywood should have both sides good. See Figure 4. The few remaining pieces are then saved and used as angle braces, shelves etc. Perhaps it should be pointed out that the width of the console is such that it will clear a regular three foot door. If you have anything less it will be necessary of course to cut this dimension down to clear your opening.

While not discernible in Photo 4, two screen door turn-buckle type braces (connected in "series" for the required length) are used across the console directly in back of the upper horizontal ¾ by 2 inch strip. With reference to Photo 3 again, the 1 by 1½ inch strip that is fastened to the bottom of the sides and to the bottom front of the unit can be seen. This is merely a trim, however it does eliminate

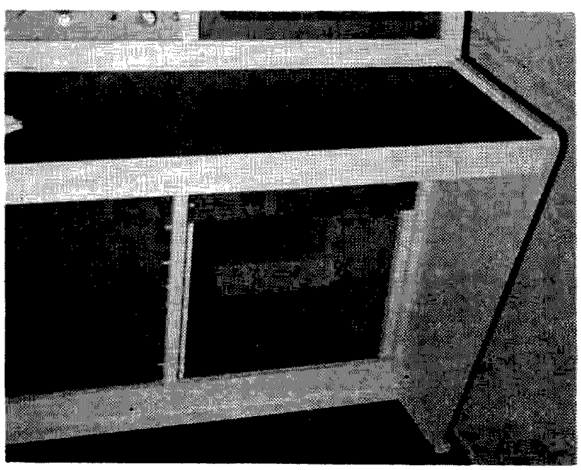


Photo 3

splitting the plywood edges when moving the console about during construction. The strip across the front edge of the desk top is used for rigidity and also conceals the small brace needed underneath in the center.

A reminder with regard to the horizontal 1 by 1½, 1 by 2 and 1 by 3 inch strips; these should be as straight and free of knots as possible. The given dimension for the *width* is the exact size used. These pieces are cut from a board a size larger to secure the final widths and are not necessarily stock 1 by 2's, 1 by 3's etc.

The finished color of the unit itself is a light gray. Our supplier referred to it as French gray. This is a rather light color and is more contrasting to the darker blue gray panels. It

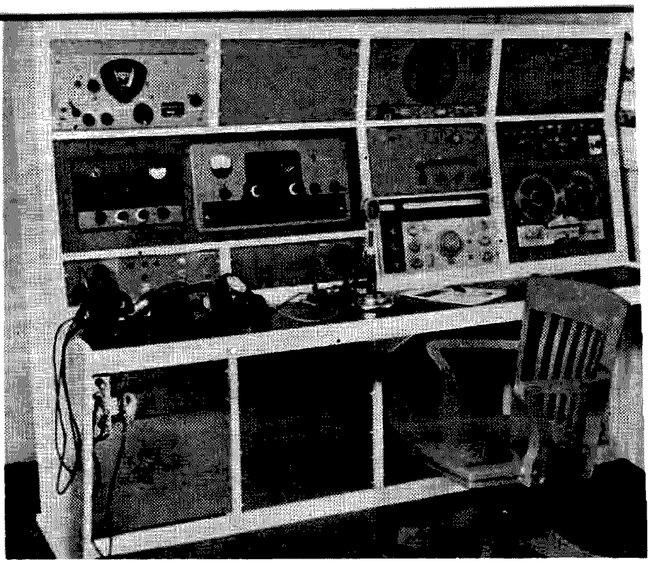


Photo 2

seems impossible to secure the same shade of gray when ordering panels, and this contrast has a tendency to make the various shades of rack panel gray less noticeable. If most of your panel gear will be home made, each panel may be given a light coat of paint from a pressurized paint can. Just a sufficient amount to change the shade of gray but not enough to eliminate the wrinkle finish.

As to the final cost of the described console; a figure of twenty-five dollars should cover practically everything that is required. The main item of course is the large 4 by 8 piece of plywood which in itself costs about nine dollars. If one desires to cover up the unused portions of the console pending the purchase of more equipment, it is less costly to use masonite board. This can be easily painted gray with a pressurized can of paint as mentioned before. Usually two coats are necessary.

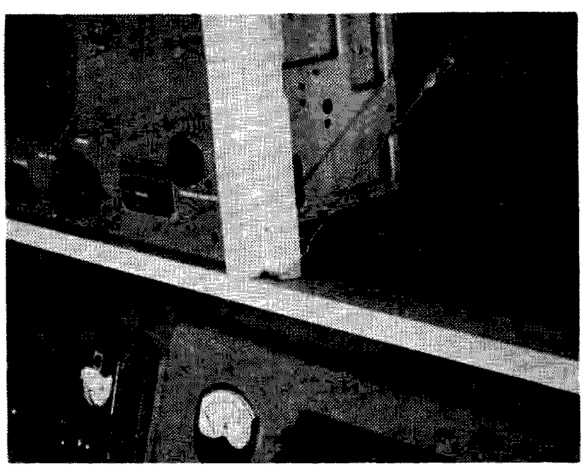


Photo 4

A brief description of the various pieces of gear as mounted by the author may be helpful. Besides the familiar BC-348, Valiant, 6N2, NC-300 etc. we have added at the lower left a 5¼ inch panel with several sockets mounted at the left. A cable with a matching plug then can be switched around to use either the Valiant alone, or the Valiant as an audio driver,

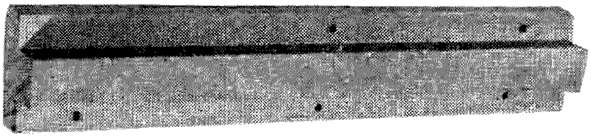


Photo 5

or to the 6N2.

To the right of this panel is the inter-com speaker so the operator will not fail to hear the dinner call. Underneath the National speaker is a 1¾ inch patch-panel strip for various audio inputs and outputs. The "eye" at the left is for monitoring RTTY signals. The 10½ inch panel to the right of the speaker contains the National VHF converter units. Directly below this is an audio termination board similar to the one below the speaker. The push-buttons above the NC-300 are used for Conelrad monitoring and WWV and CHU time signals. Underneath the desk are two power supplies and an RTTY terminal unit.

After you have completed your console you are sure to enjoy many happy hours of operating pleasure with everything in order, at arms reach and you still may alter the unit at will. *However*, don't let your visitors go behind the scenes—its one big messy mass of wires and cables.

To ascertain quickly the main items required the following list can be used as a guide.

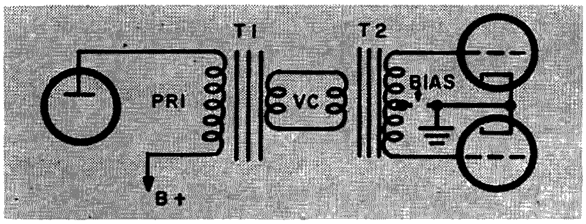
1—¾" x 4' x 8' fir plywood (sides)
1—⅝" x 17¼" x 70¾" fir ply (top)
1—¾" x 18 x 69¼" fir ply (desk top)
1—1 x 1⅛" x 79 8/16" strip
2—1 x 2 x 79 8/16" strip
2—1 x 3 x 79 8/16" strip
1—1 x 2 x 39¼" strip
1—2 x 4 x 81¼"
18'—2 x 3 fir stock (for inside vert. members)
11'—2 x 2 fir stock (for outside vert. members)

The above is for the console as shown in photograph number 2. Add to the above list the necessary nails, screws, cup washers etc.

. . . W9HKA

Interstage Transformers

It is possible to make an audio interstage transformer from two audio output transformers. The transformers are connected back to back with the voice coil windings together. While this doesn't always provide a theoretically perfect match, it will work perfectly most of the time. For details see diagram.



Class B Modulators

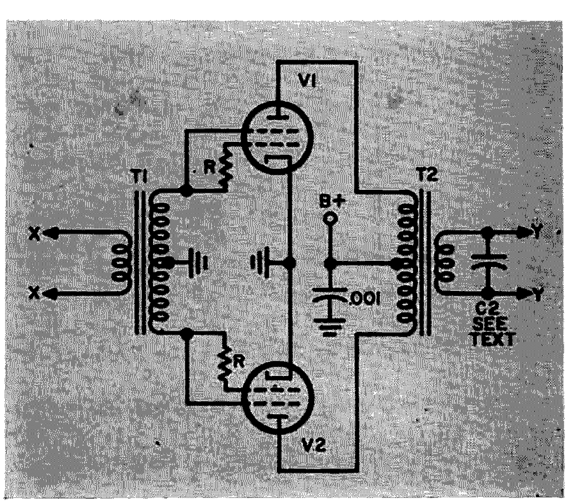
Larry Levy WA2INM

NOT many hams realize that the power supply for a plate modulator on an AM rig usually has to be larger, or as big as, the power supply powering the final.

In Class A applications, the power supply has to be able to deliver twice as much power as the final input. A Class A modulator has the maximum theoritical efficiency of approximately 30%. Practical efficiencies average about 20-25%. In an application where a transmitter of 100 watts input is being modulated by a Class A modulator, the modulator input will be between 200 and 250 watts. It could be more, as these figures are not counting transformer losses or mismatch.

Class AB modulators draw lower standby currents and therefore require a smaller power supply than Class A. The size usually is about equal to the one used to power the final. The efficiency runs about 40-50%.

The most efficient form of modulator is Class B. Class B differs from Class A and AB in that driving power is required, whereas in Classes A and AB no driving power is required, only voltage. Considering the cost per watt, it cost far less to get an additional 5-10 watts of drive than to build the additional capacity in the power supply. Most Class B circuits require a fairly stiff bias supply capable of giving a few mils of current. Several other circuits use triodes and require a large amount of drive. The most practical (and the simplest, therefore the cheapest) circuit is one using zero bias and tetrodes. The efficiency runs between 70 and 75% and the power supply can be about ½ (or even less) the size of the power supply used to power the final. It must be capable of large current peaks and well-regulated.



In a tetrode, the screen voltage as well as the grid voltage, has a lot to do with the plate current. In a case where the screen as well as the control grid are at ground potential, the plate current is extremely low, usually in the order of a few mils. When the screen starts to become positive, the plate current starts to increase greatly, as long as the grid is not negative. In the circuit shown, a very high audio voltage is applied between the screens. Resistor "R" lowers the voltage on the grid in the proper ratio. Otherwise, the grid dissipation of the control grid would probably be exceeded, as well as the fact that so much positive voltage would drive the tube into saturation and cause severe distortion.

In a typical cycle, with no signal, the screens and control grids of both tubes are at ground potential and the plate current is extremely low (5 mils per tube with 807's). When an audio signal is applied, on the first half of the cycle, one of the tubes (call it V1 for convenience) starts to conduct because of a positive voltage on the screen and control grids. At the same time, Va is driven beyond cutoff by the negative voltage on both grids. At the end of the first half of the cycle, both grids are at ground potential, and on the second half of the cycle the same thing happens with V2 conducting and V1 cut off. About 100 to 400 volts of audio are required between the screens, or 50 to 200 volts from each screen to ground. This varies with the tubes and power level at which the tubes are run.

T1 is an input transformer, the impedance matching the driver and the modulators. One possibility is to use a small hi-fi or PA amplifier to drive the modulators with T1 being a PP plate to voice coil transformer wired in reverse. Usually one delivering about 5 watts will do fine. T2 should match the modulator plates to the final. Sometimes connecting a small capacitor across the secondary of the modulation transformer will improve the quality of the modulation. If you desire to experiment, C2, which is optional, can be between 500 mmfd and .01. Usually one about .005 works well. The voltage rating should be at least two or three times the plate voltage on the final. The purpose of this condenser is to reduce some of the higher order harmonics of the audio signal. This will help reduce the

bandwidth of the signal. These harmonics, as well as higher frequency fundamental signals, may be present at the input of the modulator. There is also a possibility of the modulator itself generating some harmonics.

Using this basic circuit, modulators in almost any power class can be built. The one I am using uses 807's to modulate a 100 watt transmitter. The plate voltage is about 350 volts. The value of R is 27K. Approximately 3½ watts of drive are required. The standby current for two tubes is 8 ma. On modulation peaks this increases to about 220 mils. Using 750 volts and a little more drive, this same modulator can fully modulate a transmitter in the 200-250 watt power class. At 750 volts on the plate, the standby current is only about 15 or 20 mils. For lower power rigs, 6V6's will give about 18 or 20 watts output and will nicely modulate a 40 or 50 watt transmitter. 6L6's have more than enough modulation for a 6146, 807 or any transmitter up to about 80 or 90 watts.

The power transformer used in these modulators can be one taken from an old TV or radio. There is not mucn load on the power transformer as the peak currents are drawn for relatively short periods of time. Most of the time the standby current is only a few mils and this gives the transformer a chance to recover.

One possibility for a modulator tube is the 1625. The characteristics are identical to an 807 except that it has a 12 volt heater and a different socket. They are available for about 25¢ surplus and a pair of them are capable of modulating a 200 to 250 watt transmitter. They can be run at lower power levels, run quite cool, and are efficient. For lower power levels it is more practical to use lower plate voltages, as the efficiency (practical) increases when the tube draws lower standby current.

This modulator has been in use for over a year without any failures in tubes or components. The reason I mention this is that most of the parts come from the junkbox and some of them (especially in the power supply) are being subjected to overloads of 300-500 percent (on peaks). The results have been excellent and this modulator combined with speech-clipping in the driver completely modulates the transmiter at a cost lost lower than the power supply alone of a Class A modulator.

. . . WA2INM

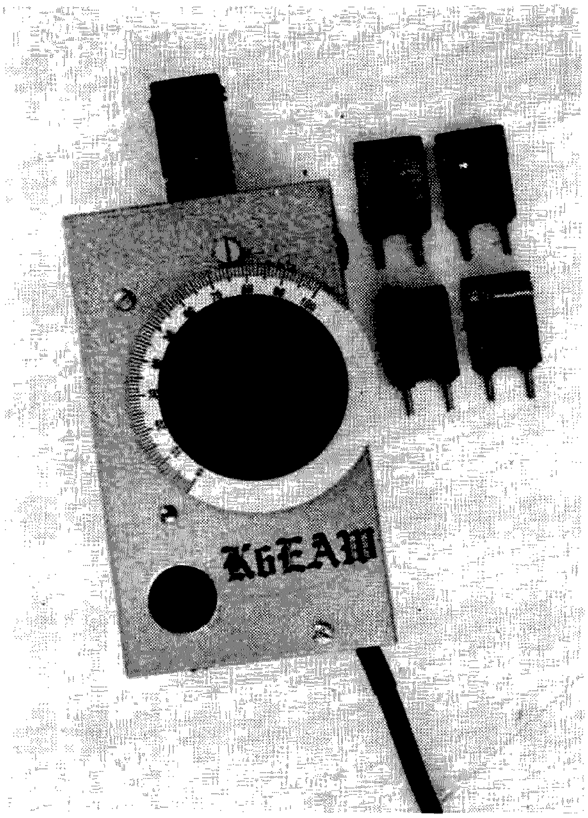
Letter

Dear Sir:

This will acknowledge your letter of recent date regarding amateur radio call letters on registration plates. You are advised that no call letter plates are to be issued under the present plans for 1962.

William S. Hults
Commissioner of Motor Vehicles
State of New York

New York is a rotten state.



An "Eye" For Resonance

Roy A. McCarthy K6EAW
737 W. Maxzim Ave.
Fullerton, California

IF YOU don't have a grid dip oscillator you are probably missing out on a lot of the fun of ham radio. Simply knowing a new circuit is in tune before applying the power to it can change frustrating initial tune up procedures into pleasurable operating. Of course the GDO is far from being new, but the added expense is sometimes a bit too rough for hams on a limited budget. This one cuts the cost practically to the bone, especially if liberal use is made of junk-box parts rather than insisting on exact duplication. None of the components are critical in value.

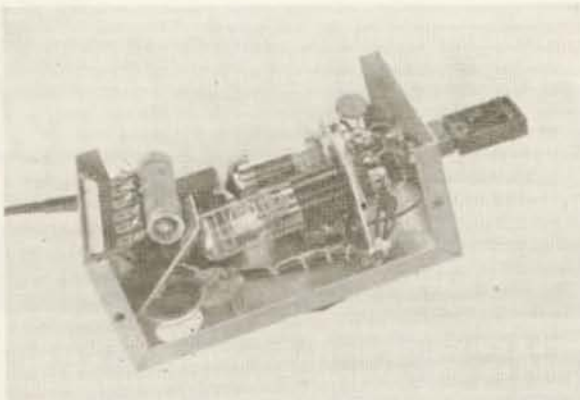
Use of a tuning eye instead of a meter not only cuts down on the expense, but has a further advantage in that sharp dips can be detected which might be passed over with a meter. This is due to the instantaneous response of the eye. The major disadvantage of a tuning eye, namely the limited life of its brightness, was overcome by mounting it inside the case and using a simple optical system for viewing.

The instrument was intended mainly for use on the 6 to 80 meter bands. These are covered by four coils, each of which covers at least two ham bands. The inductance was adjusted so that a single calibration chart could be used for these ranges. A fifth range, covering approximately 50 to 100 mc was added, but no attempt was made to adjust it to the chart for the other ranges. This range acted a bit peculiar, since it was approaching the upper frequency limit of the circuit.

The circuit uses the familiar Colpitts oscillator tuned by a two gang midget superhet type capacitor. The oscillator grid voltage is monitored by the miniature tuning eye. To allow for variations in the grid voltage developed in the oscillator a sensitivity control, R4, in conjunction with R2 acts as a voltage divider to set the eye's grid bias until the eye is nearly closed. A tuned circuit coupled to L1 absorbs power from the oscillator, reducing the grid bias, and causes the eye to open slightly, indicating the resonance frequency of the tuned circuit.

A filament transformer was used to furnish heater power for the two tubes, and a simple half wave rectifier and capacitor filter supply about 150 volts of B+. The only connections to the case are through the tuning capacitor frame and the rf bypass, C4. This prevents any possibility of getting a shock from the power line. The coil is isolated from any dc voltages present by C2 and C3. Use of overrated capacitors will provide just about as much protection as the oil impregnated paper in most low cost transformers; however, for peace of mind a transformer using a 115 or 130 volt winding could be used to isolate the few milliamps used in the B+ supply.

The GDO was constructed in an LMB Tite-Fit Chassis Box #780, which is 5¼ x 3 x 2⅛



inches. All components used were standard radio parts except the tuning eye. The one used is a 7 pin miniature version made in Japan. These are made there by several manufacturers and are known interchangeably as the 6E5M and 6ME5. A regular 6E5/6U5 could be substituted if enough space is allowed for it in the layout. The tuning eye was mounted inside the case alongside the 6C4. A plain mirror is used to project the image through the hole in the top of the case. A small plastic lens is mounted just below the hole to provide magnification of the image. This provides easy viewing even in brilliant daylight. The mirror can generally be found in the xyl's discarded purse and cut down to size with a dime store cutter. The lens used was found in a box of Cracker-Jacks but similar ones are available in the Five & Tens.

Use of a crystal socket for the coil socket permits testing surplus crystals to check their activity and approximate frequency. The crystals which are defective can be dismantled and used for the coil forms. The cover is removed and discarded as are the various pieces of hardware inside. A piece of 1/16 inch plastic or similar insulating material is cut to fill in the space under the coil so that the turns wound on there will not be deformed by handling. The plastic should be cut a bit short so that the wires can be inserted into the cleared out pins. Incidentally, cleaning out the pins (of the old solder) is simple if you merely heat them with the iron then give a mighty whoof of air into the xtal holder.

Wind the lowest frequency coil first and after checking its performance coat it with Q coil dope quite liberally. Each higher frequency coil is then wound in turn, checking its tuning and adjusting the inductance as required by removing extra turns or folding back part of a turn. Adding the polystyrene Q dope has a negligible effect on the tuning. The higher frequency coils can also be adjusted slightly by spreading a turn or two away from the main winding.

A simple commercial dial calibrated from 0 to 100 was used in place of the usual hand calibrated dial. A graph was plotted showing frequency vs. dial reading and cemeted to the bottom of the dipper, with a protective coating of plastic. The extra care used in trimming the coils paid off in an easy to read calibration chart, and 3.5, 7.0, 14.0 and 28.0 are at exactly the same spot on the dial.

Since the receiver in the shack only covers the ham bands it was used only for accurate spot checking of the frequency coverage. The remainder of the calibration was accomplished with the aid of an all band signal generator. Removing the cover of the signal generator exposed the coils & allowed using it as an accurate absorbtion wavemeter. The extra high band coil was calibrated by QRMing the TV set.

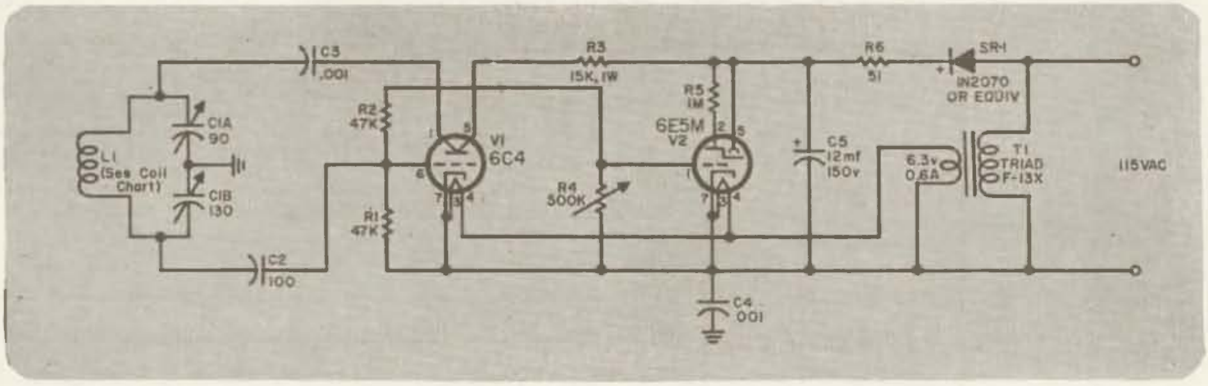
The construction and wiring are not particularly critical in view of the low frequency coverage intended. The best procedure is to get together the major component parts, then determine the layout and size of case needed. Individual calibration of the oscillator can be made a game rather than a chore by first winding a test coil to see what the circuit will do, then trying to wind the coils as close to the calculated numbers as possible.

. . . K6EAW

Coil Table

	Range	# turns	Wire size
A	3.2 to 7.4 mc	70	28
B	6.4 to 14.8 mc	24	28
C	12.8 to 29.6 mc	9¾	28
D	25.6 to 59.2 mc	3¾	28
E	50 to 100 (approx) mc.	1¾	18

All coils were close wound (except E) at the top of FT-243 crystal holders. Coil E had the turns spaced approximately 1/16 inch.



Break-In a la Transwitch

Ernie Austin W7AXJ
Bob Austin K7DVB
3211 S.E. Franklin St.,
Portland 2, Oregon

4 transistors	22½ positive volts
5 resistors	110 negative volts
3 potentiometers	Dash of capacitance

Mix judiciously. Connect to transmitter, receiver and TR switch. Adjust potentiometers for optimum operation. Place rig on air carefully. Relax and enjoy the finest and fastest CW break-in operation ever heard.

A transistor can readily be used to take the place of a relay in low current switching circuits such as grid-block transmitter keying arrangements. A typical circuit is shown in Fig. 1. The voltage applied to the emitter of the transistor can be as shown or may be obtained from sources such as the collector of the output transistor in the W5LAN version of the popular "TO" keyer. (Marland M. Old, W5LAN, "Transistorized Electronic Key and Monitor," QST, May, 1959.)

Break-in operation requires some form of control of the receiver gain. This, too, can be accomplished with a transistor. There are so many different circuits in use for receiver muting, however, that it would be impractical to attempt to describe how transistors could be applied to all of them. Therefore, this article will be confined to one arrangement which has been used successfully with the hope that it will inspire other circuit designers to develop units with broader application for presentation to the communications fraternity.

A particularly effective form of receiver muting is shown in Fig. 2. It will be recognized as the circuit used in some of the

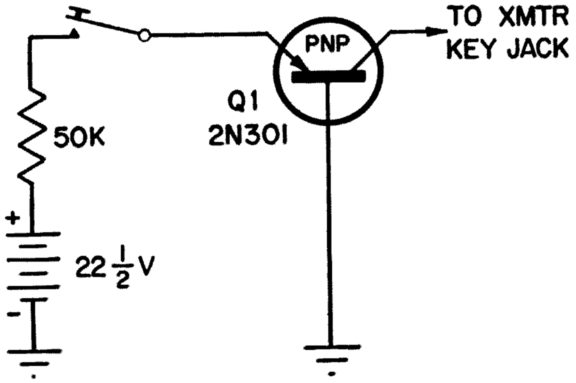


Fig. 1—Using a transistor in a transmitter grid-block keying circuit.

Hallicrafters receivers in which the sensitivity is controlled by varying the cathode resistance of several tubes. The "Monitor" potentiometer controls the receiver gain on "Standby" so that the receiver can be used to monitor the transmitted signal.

The transistor in the upper half of Fig. 2 has been added to the original circuit to reduce the sensitivity of the receiver when the key is closed and restore the receiver to normal sensitivity when the key is opened. The "Rec-Stby" switch is left in the "Stby" position when the transistor is used. Also the condenser which shunts the sensitivity control in the original circuit has been rewired so that it, too, is lifted from ground when the receiver is muted. This makes the receiver recover its sensitivity more rapidly so that breaks between dots can be heard at high keying speeds.

A "Muting Level Control" may be connected as shown in Fig. 2 and extended to some convenient location on the operating desk. This

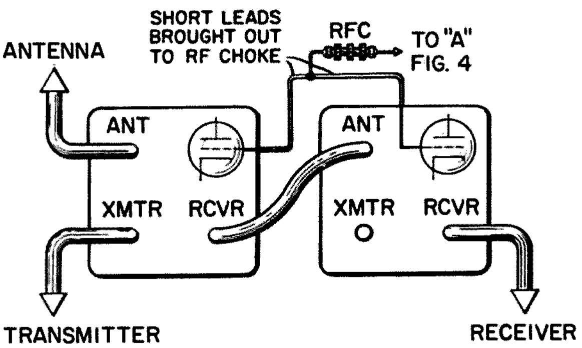


Fig. 5—Using two TR switches to increase isolation between transmitter and receiver.

makes it possible to adjust the monitoring volume level while transmitting. This control is labelled R1 on the diagram. When it is used the "Monitor" control is set at minimum gain.

It will be seen that two of the basic requirements of break-in operation have been met. However, these two circuits cannot readily be operated from the same keying source without too much interaction. It is advisable to introduce a third transistor.

Fig. 3 combines the circuits of Fig. 1 and 2 and adds the third transistor. Note that the first two transistors were PNP types while the third one is an NPN type. The base

of Q2 is now keyed by Q3 which, with its associated resistors and the negative potential source, take the place of the 15 volt battery and 15K resistor used in Fig. 2. The voltage divider potentiometer R3 determines the operating point of Q2 through Q3. It is adjusted for maximum receiver gain with the key open. The 0.5 mfd capacitor from the base of Q2 to ground and the 150K resistor, R4, from the collector of Q1 to ground, improve the timing characteristic of the circuit which is controlled by the 100K resistor R2.

The timing action of the circuit is shown in Fig. 6. The receiver gain is reduced to a very low level before the transmitter is turned on and the transmitter is turned off before the receiver gain is restored to normal. The amount of time between "receiver off" and "transmitter on" is the timing characteristic which is controlled by R2. R2 also affects the leading edge of the transmitted signal at some settings.

If the transmitter comes on before the receiver gain is reduced keying thumps will be heard in the monitored signal. These thumps will be generated in the receiver, giving a false indication of the signal transmitted on the air.

With some transmitter-receiver combinations using a TR switch this combined circuit may be adequate. However, if it is necessary

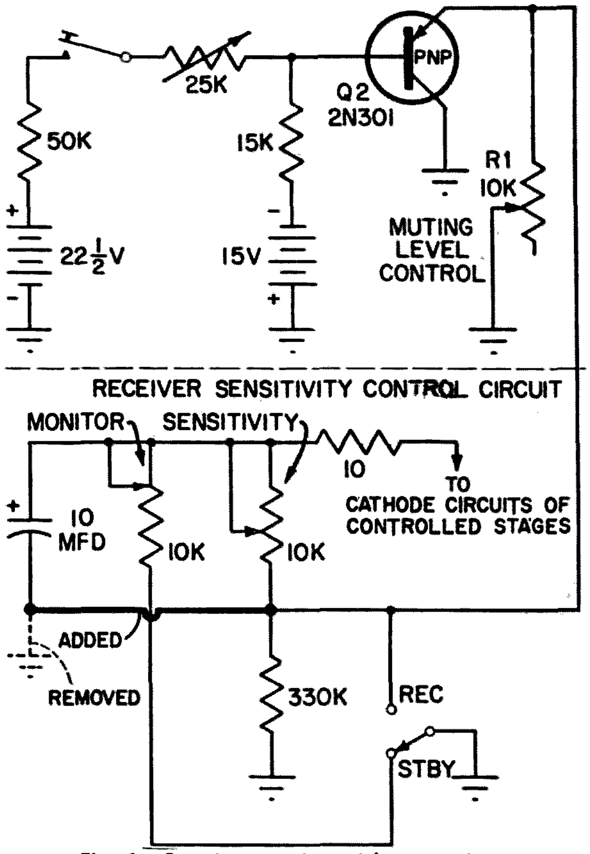


Fig. 2—Receiver muting with a transistor.

to reduce the level of the signal reaching the receiver from the transmitter through the TR switch, this can be accomplished with another transistor and use of the negative potential supply as a source of cut-off bias for the TR switch. See Fig. 4 and 5. The key-down bias may be insufficient to adequately cut off the TR switch and help reduce keying thumps. If this is the case the bias voltage at the TR switch grid can be increased by adding a second transistor as in Fig. 4a.

With high power it may be necessary to introduce more attenuation between the transmitter and receiver. In this case, two TR switches can be used. They should be connected in series and blocked simultaneously as in Fig. 5.

We now have an integrated break-in system using no relays. Breaks between dots can be heard at speeds in excess of sixty words per minute. The transmitter sounds like some other station strong enough to override the noise. The volume of the monitored signal can be adjusted to any desired level by means of the muting level control. Any QRM which develops during the QSO can be readily noticed while transmitting. CW operation similar to VOX operation on SSB becomes a reality (if the other station is similarly equipped). And —there is no sound of relays clattering in the shack.

Adjustment: R1 is the muting level or monitoring volume control. R2 is adjusted for

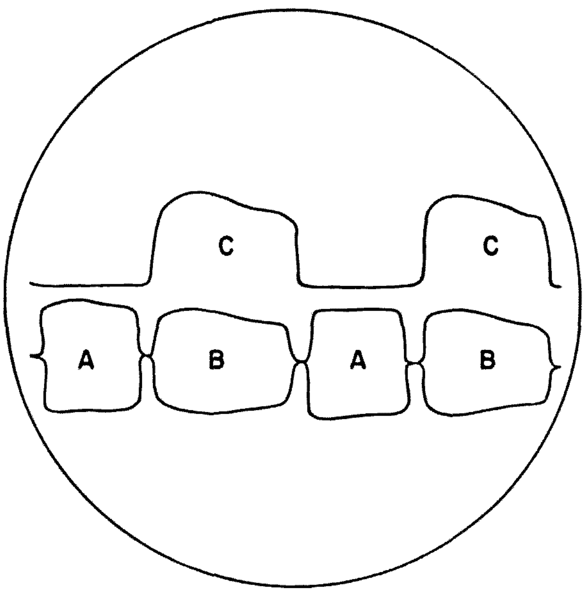


Fig. 6—Tracing of oscilloscope presentation of waveforms in antenna and in receiver if using the deluxe transistor break-in circuit. An electronic switch was used. The upper trace is from a demodulator probe at the transmitter output. The lower trace is from the receiver if with the receiver tuned to a steady carrier. The transmitter was keyed with steady dots at 18 dots per second (45 words per minute). The incoming carrier heard in the receiver is marked "A". The monitored signal in the receiver is marked "B". The transmitted dot in the antenna is marked "C". Note that the signal in the if drops to zero then returns to full sensitivity between dots.

minimum clicks in the receiver when transmitting, consistent with good transmitter keying. R3 is adjusted to the lowest value which will give maximum receiver sensitivity with the key up.

Construction: All resistors shown in the diagrams are ½ watt. The potentiometers are volume control types and the capacitor can be rated at any value above 110 volts. The transistors may be placed in the circuits which they control or they may be mounted together with extension leads to the various circuits. At W7AXJ they are mounted in a small chassis with the electronic bug. There is no need for special construction practices except where there is excessive rf in the shack. In this case it will probably be necessary to shield the leads to the transistor bases where they are remote from ground. A better solution would be to shield the transmitter!

Use of transistors: Many words have been written on the theory and application of transistors. No attempt is made here to improve on the literature. Two simple precautions are recommended while experimenting with transistors in switching circuits. (1) Use a fairly high resistance in the base lead and (2) Limit the total current through the transistor to the amount specified by the manufacturer under "Characteristics for Switching Applications." Do this with suitable resistors in the emitter

Fig. 3—Break-in circuit using transistors in place of relays.

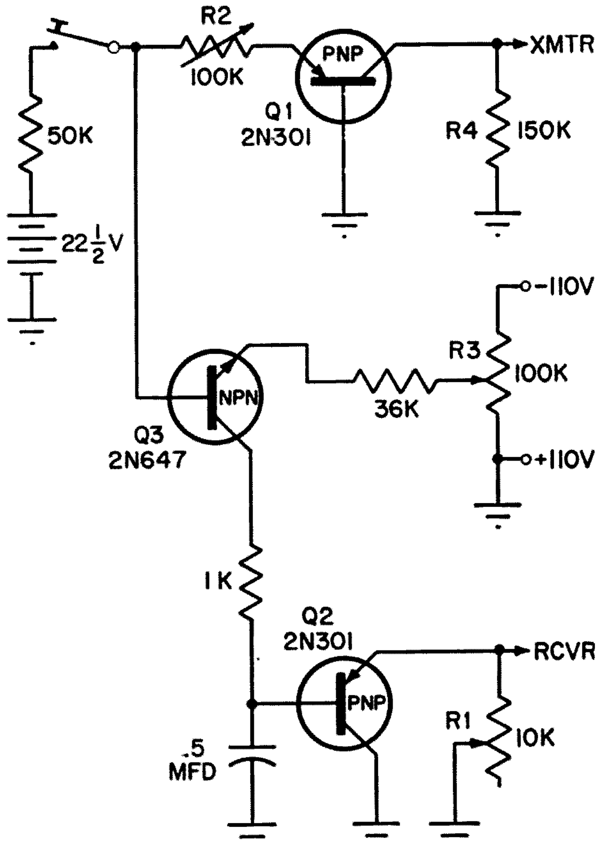
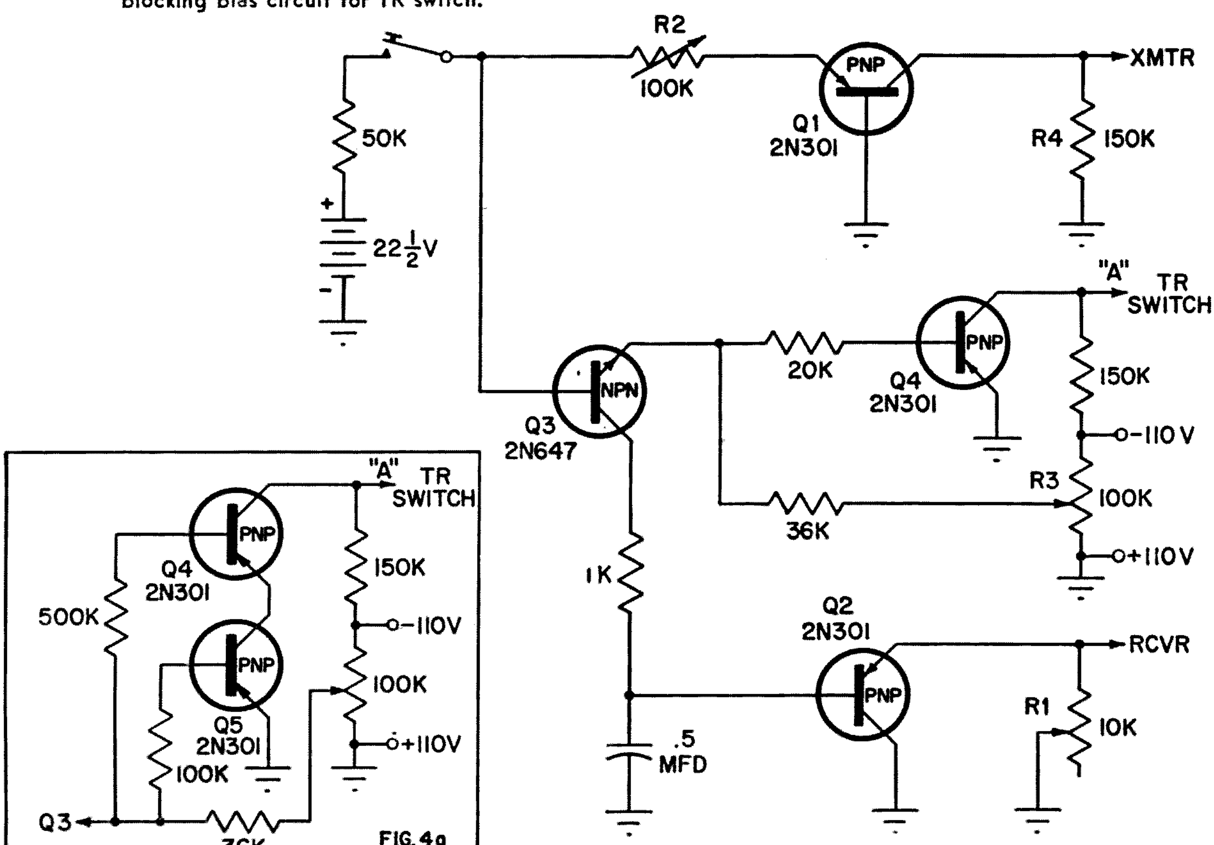


Fig. 4—DeLuxe transistor break-in circuit with blocking bias circuit for TR switch.



and collector leads.

A transistor will handle a surprising amount of current between emitter and collector while in the saturated condition since the internal resistance is low and the dissipated power is therefore low. The dissipated power is also low in the cut-off condition, where the resistance becomes relatively high and the current through the transistor becomes very small. In this condition it is necessary to be careful that the voltage across the transistor is not excessive.

The transistor types shown in the diagrams need not be used. Any similar type should be satisfactory. Buy yourself a handful and hook them up. You will be pleased with the results —but watch that base current!

. . . W7AXJ-K7DVB

Environmental Testing

Joseph Leeb, W2WYM
549 Green Valley Road
Paramus, New Jersey

It shouldn't happen to a dog—but it *does* happen to electronic components and assemblies that go into military equipment. I refer to the inhuman treatment, called Environmental Testing, that parts must undergo in order to prove their reliability under the most extreme conditions to which they may be exposed.

Take a communications receiver, for example. If it is manufactured for home use, it generally settles down to a pampered existence in somebody's shack, once it has completed its journey from the manufacturer to the consumer, with possible stops at the distributor's and the retailer's. Not so with equipment designed for use in planes, ships, tanks or submarines.

Let us study a receiver built for aircraft use. It must operate reliably when the plane is taxiing for a takeoff, when the engines are revving up, and when the plane is airborne. It must not fail when the plane climbs to 30 or 40 thousand feet, or when it lands on a bumpy airstrip in the burning desert. The receiver must be made immune to humidity and treated against fungus, sand, and salt water spray.

How does Uncle Sam assure himself of reliable performance? By means of exhaustive, painstaking, brutal Environmental Testing. The most severe conditions that the component or unit is likely to encounter are simulated in the test laboratory. Let us start with vibration. Here the equipment consists of an oscillator, a power amplifier and a shake table. The frequency of the oscillator is adjustable from zero up to somewheres near the upper end of the audio range. The amplifier must have sufficient output to give the unit under test the shaking of its life. A ten pound unit requires a 5 KW amplifier. The shake table is really an enormous electrodynamic loud speaker, with the voice coil anchored to the vibrating platform. The field winding alone requires 5 amperes at 200 volts dc (1000 watts!) for its excitation.

The unit is tested in each of its three mutually-perpendicular planes. If a man were to be given a vibration test (let's hope it will never come to that!) he would be shaken first standing up, then on his back, and, finally, lying on his side. In each position he would be securely anchored to the shake table.

Now comes the "search". The oscillator dial is swung slowly back and forth to determine the resonant frequency, or frequencies, of the test unit; in other words, the point or points on the dial where it vibrates most violently. While vibrating thus, the unit is fed rated voltages and its performance is monitored.

To make sure our unit will not conk out it taken to a place like the DEW line, it is put in a deep freeze at 65 degrees below zero, tested, then quickly put in a thermostatically-controlled oven, at a temperature higher than the heat inside a boiler room on a midsummer's day. This is known as the "Thermal Shock" test.

In order to find out how our unit fares when the plane is accelerating or decelerating, we simulate the condition by placing the unit in a spin chamber. Again, rated voltages are fed in and performance monitored.

How will our unit do in the stratosphere? A vacuum chamber, with simulated high-altitude conditions, tells the story,—where insulation breaks down, where capacity and resistance values change, and in what manner performance may drop off.

The end result of a rough landing is determined by means of drop, jolt and jumble tests. The drop test is exactly what the name implies. The unit is dropped from a specified height and the resulting damage, if any, noted. A platform, to which the unit is bolted, is jolted by a prescribed force. In the jumble test, the unit is bumped in a random manner, designed to show up weaknesses in the fastenings.

We now go into the "Steaming Jungle Room" for the humidity test. Several hours of exposure to a saturated atmosphere, a salt spray test and a sojourn in the fungus chamber will decide the fitness of our unit for service on

a tropical isle.

Before the unit is subjected to the aforementioned treatment, the individual components must prove their worth. Capacitors are carefully checked for leakage, breakdown voltage, power factor and dissipation factor, under various environmental conditions. Resistors must prove themselves within specified limits of ohmage, and current-carrying capacity under extreme heat and cold. Fuses must blow within the specified number of milliseconds after application of current, as measured by an electronic counter. The hermetic seal on the ferrules must permit no moisture to leak in at high altitude or pressure. How do we detect the presence of a droplet of moisture hardly bigger than a molecule? Test fuses are dropped into a beaker of fluorescene solution, and the beaker placed in a vacuum chamber. After taking the fuses up to the required altitude or pressure and back to sea level pressure, the components are rinsed in running water and examined under ultraviolet, or "black" light. The most minute particle of fluorescene will glow brightly under this influence.

Hookup wire is checked for insulation resistance and breakdown voltage, in addition to resistance per foot and mechanical dimensions.

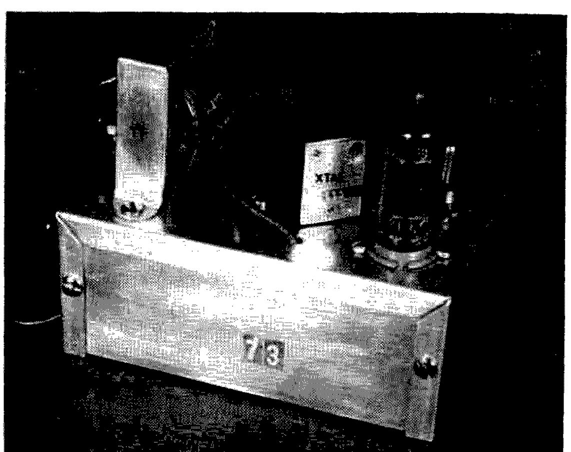
Connectors are checked for insulation resistance, voltage breakdown at high altitude, and contact resistance, among other things. In the contact resistance test, rated current is passed through each pair of mating contacts and the millivolt drop is recorded. This calls for a 4-wire hookup—two wires for feeding the current into the connectors, and two wires from the millivoltmeter to specified points on the connector contacts.

If the unit is to operate near combustible gases, it must be made explosion-proof. Every pair of make-and-break contacts must be bypassed with capacitors or Zener diodes, to completely eliminate arcing. Elaborate grounding must be employed if the unit contains moving parts that might generate static electricity. Connectors must have hermetic seals.

A sufficiently large random sampling of a production run is made for environmental test purposes to ensure reliability of the end product. For example, the specification may call for the testing of 10%, or a minimum of 50 pieces, out of each lot, regardless of how small the lot may be. It frequently happens that the entire lot must be destructively tested, if the lot happens to be a small one.

So—next time you buy a piece of surplus equipment, treat it with respect—it has been through fire and was not found wanting.

. . . W2WYM



All Band Band Edge Marker

Charles Berner WA2HRZ
125 Navy Walk
Brooklyn 1, New York

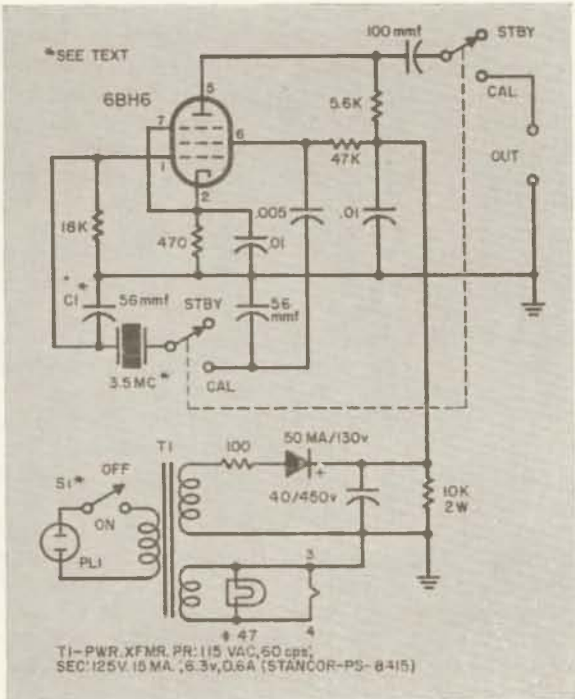
Photo taken by S. Blechman

A while ago, the editor of this magazine gave some advice to teenaged hams concerning the writing of articles for 73. I took this advice and, after hocking my switchblade, bought the necessary parts for this undertaking with the money raised from this sale.

I had a commercially made 100 kc xtal calibrator whose performance didn't satisfy me at all. I reasoned that since the ham bands are harmonically related, why not use a 3.5 mc xtal to obtain the marker signals. Table 1 shows that the higher you go in frequency, the higher the multiple of the fundamental. As the multiple increases, the signal strength decreases, and by the time you get up to 10 meters you have practically nothing. Not so with a 3.5 mc marker; the eighth harmonic will place you right on 28.0 mc, while the 280th harmonic is needed with a standard calibrator. This makes some difference in signal strength! This unit has been tested on 1¼ meters and works quite well.

Believe it or not, the total cost of this gem is only about $11. In fact it cost me exactly $11.79, including the confounded 3% city sales tax. This nominal investment shows that by homebrewing your equipment, you can double the performance of a commercial unit at half the cost.

This calibrator is complete with its own ac supply, eliminating the need for taking power from the receiver. If ac outlets are at a premi-



um at your shack, the on-off switch and the line plug can be eliminated and the ac line connected across the receivers ac input so that the calibrator comes on whenever the receiver is turned on. A high density selenium rectifier was used and this contributes greatly to the compactness of the unit. The whole thing runs very cool and even after 24 hours operation, still isn't hot.

Wiring isn't too critical, but keep all leads short and direct. Using an octal socket for a xtal holder lets you use the unused pins as tiepoints and is recommended.

A Petersen type Z-2 xtal was used because it has a tolerance of .002%. This is one reason why no provision is made for "zeroing" the calibrator against a standard. The other is that there isn't any such standard as WWV for use. However, if this provision is desired, C1, the 56 mmfd capacitor, connected to pin 1 of the 6BH6 thru the 18K resistor, can be made variable. Also, if band edge markers are wanted for 50 mc and up, a 5 mc xtal may be substituted when this function is wanted and C1 made variable for "zeroing" against WWV.

This gadget can also be used as a xtal activity checker by simply replacing the marker xtal with the xtal to be tested. Tuning your receiver should get you a strong signal at the xtal's fundamental if it is OK.

I would appreciate hearing from anyone who has come up with additional uses for this unit. Please send all letters to my home QTH as Wayne may think that they are bills and burn them.

WA2HRZ

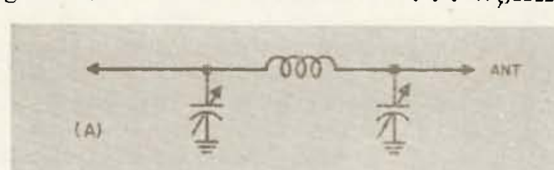
Table 1:

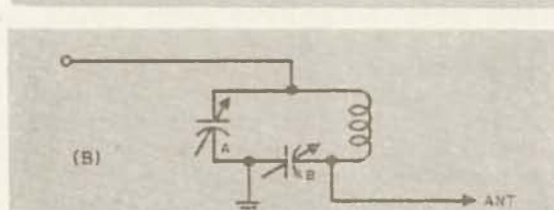
Band	Harmonic 3.5 mc	100 kc	Marker Frequency
80 meters	1	35	3.5 mc
40 "	2	70	7.0 mc
20 "	4	140	14.0 mc
15 "	6	210	21.0 mc
10 "	8	280	28.0 mc
6 "	15	525	52.5 mc
2 "	42	1470	147.0 mc
1¼ "	63	2205	220.5 mc
1¼ "	64	2240	224.0 mc

Pi

The Pi output circuit (A, above) has practically supplanted its predecessor the parallel tuned circuit in modern day ham transmitters, and is so-called because of its resemblance to the 16th letter of the Greek alphabet, π. The Collins Radio Company is generally given credit for first making extensive use of it and indeed it is still referred to in some quarters as the Collins coupler. The circuit can be redrawn as in B, above, to permit comparison with the more familiar parallel tuned circuit. "A" is the tuning capacitor and "B" the loading capacitor. With "B" at full capacity (minimum loading) the antenna connection point is practically at ground potential. With "B" toward minimum and "A" retuned to maintain resonance more and more power flows out the antenna as it is in effect disconnected from ground.

. . . WØHKF





Tell The World

How to Get Free Publicity

Jim Kyle K5JKX/6
1851 Stamford Ave.
Santa Susana, Calif.

If my boss ever reads this article, I'm liable to find myself fired. Because by trade, I'm a newspaper reporter—and we're supposed to foil publicity attempts, not encourage them.

But if you follow the instructions I'm about to give you and come to see my boss, I'm not worried about the job coming to an abrupt end. If you do this, what you have to offer will be news, not publicity—and news is what we're paid to find.

Let's back off a little and start at the beginning. Why do we, as hams, want publicity?

That's not so easy to answer as it sounds. Too many of us just want to see our names in print, to have something to show off.

But the major reason, I hope—and the reason I'm writing this article—is that without good publicity, our hobby stands in serious danger.

Frequency allocations are valuable. As Wayne has been telling you repeatedly, while commercial interests are aware of the value of amateur radio in providing tomorrow's engineers, they forget about our value when they see all that space we take up—space that they want!

So far, we've done fairly well in keeping ourselves in existence. We've lost only two bands in as many years. But we have to keep at this business, and one of the best tools for doing so is publicity.

A former governor of the state of Oklahoma had a famous saying: "There ain't no such thing as bad publicity."

He wasn't completely right, but too many of us are shrinking violets when it comes to telling the world of our services and accomplishments as hams. And we're so afraid of bad publicity at times that we forget that any subject can be handled at least two ways. Even TVI can be made palatable with proper treatment.

So now you know that the aim of publicity is to promote the good name of ham radio rather than to blow the horn of any particular amateur. How do we go about doing this?

There's a simple two-part formula that will get you space in almost any publication or air time on radio and TV. It's this: 1—Do something worth while, and 2—Let the news media know about it.

Let's take a closer look at this. It may sound a little bit too simple to work out, but it's not.

By "doing something worth while," I mean something that John Q. Televisionviewer will think is worthwhile. You know and I know that it takes a tremendous amount of skill to work all states on 144 mc or to snag some rare DX. But is it worthwhile?

Not to old John Q., who thinks 144 megacycles means a gross of those things traffic cops ride on.

But any of your public service activities are horses of significantly different hues.

For example, in Oklahoma there's a storm warning net which operates on 3850 kc. These boys track tornadoes, and it's easy to show that their activity has saved a number of lives.

That's something worthwhile.

As a matter of fact, in the last two years I've written four feature stories about this same bunch of hams. Every one of these stories has proved to some 300,000 readers that hams are public-spirited citizens.

Or civil defense work. There's something worth plugging. There are all sorts of photo possibilities in the workings of a CD net, possibilities that any photo editor in his right mind, with a view to local news, will jump at.

You don't have to do anything big and ambitious, though. Nearly every one of us has, at some time or another, helped a fellow ham do something. Maybe the other fellow is paralyzed and can only communicate with the world via radio, and you've helped him get a new rig in place.

That's human interest, friend, and that's what the editors go into ecstasy over.

Or if you like to handle traffic, possibly you have taken messages from servicemen overseas on holidays or birthdays.

Actually, the list is nearly endless. Just remember, look at your accomplishment through the eyes of someone who knows nothing about the technical end of radio and cares less, and evaluate it from his viewpoint.

If it still seems interesting, brother, you've got a story. But if it only appeals to another ham, put it on the shelf and try again.

So you've decided you have a story; what do you do next?

First, here's what *not* to do. Don't, under any circumstances, call the editor just at deadline time and ask him, "How about some publicity for ham radio?" Not only will you get turned down flat, but hams' names will be mud with that particular editor from then on.

Instead, call him at a lull hour—for a morning paper, that's about 2 p.m., and in the case of an evening paper, about 3:30 to 4 p.m.—

and tell him you think you have a human-interest (or public-service) story possibility.

You might present it this way: "Mr. Smith, my name is Joe A. Hamm. I'm a member of a group of people here in Anytown which has organized to provide emergency communications for disasters or civil defense. There are 17 of us in the group—all local people—and we're working with the sheriff's office to help out whenever they need us. We're having a meeting Friday night, and I thought you might like to get a story about our public-service activity. ,

With that kind of presentation, he's not going to turn you down cold. Even if he can't get a reporter out to cover your meeting, he'll be interested in hearing more about your activities.

And you've got the foot in the door toward good relations with the press.

An even better approach, actually, is to locate a friend who's a friend of the editor. Through the mutual friend, get acquainted with the editor on a personal basis. If you can't work it with the editor, get a reporter instead. The idea is to know somebody in the news room.

Then, when you have the editor or reporter hooked, get him interested in what you're doing. Follow the ancient secret of the female race and let him chase you until you have him where you want him.

Plant your human-interest or public-service possibilities in his path, but let him think he's discovered them for himself. He'll be a lot more enthusiastic about them if you do.

And don't ever expect friendship to keep him from printing any bad publicity. That seldom happens. The way to avoid bad publicity is to prevent unpleasant incidents from ever happening in the first place. If it happens, and the newsman is worth his pay, he's going to print it.

An important point in this business is to let the media know in advance, wherever possible, what you're doing.

If you have a CD drill, for instance, and wait until it's all over before telling about it, you'll be lucky to get a two-paragraph item listing the names of those present.

But if you plant it in advance, then the editor can send out a writer and a photographer and make a major feature out of it. And in the newspaper or TV news business, good local features are worth their weight in gold. They're rare.

Be prepared for what seem like stupid questions. Chances are the reporter who handles the story will know from nothing about radio. He's going to ask some foolish questions. If he doesn't, he's not getting your complete story. You just be ready to answer them in language he—and his readers—can understand.

Ham talk is full of abbreviations. U cn see hw odd it is at times, but when ur in QSO both you and the guy on the far end are talking the same lingo.

The reporter won't know the language, unless you're lucky and find another newspaper office with a ham in it.

Don't think he's stupid just because his questions sound that way. Would you know what to do if someone told you to: "Put a set of dingbat lines on that four-column and rush it up, I need it for the first!"?

If you take a little time to make sure the reporter understands exactly what you're up to, you'll get a better story out of him, and the publicity will achieve its purpose.

But don't go too far and try to tell him how to write the story, or ask him to let you go over it after he's through.

Any newsman worth his pay is a specialist. He knows at least one thing well, and that's how to write. Most of them spend most of their time writing about things which are foreign to them, and they're pretty good, as a rule, in this matter of getting the details correct.

He'll be touchy about you going over the story. To him, that means you want to censor his work. As a matter of fact, he even hates for the editor to check his writing when he turns it in!

But if he seems completely confused, it won't hurt to offer—*not ask*—to go over the piece with him when it's finished to catch any possible errors or mistakes in detail. If he's really mixed up about what you're doing, he'll appreciate the help.

If this happens, be careful. Don't say a thing about his writing or his approach to the story. Just watch out for technical goofs such as a transmitter on the "one-kilowatt band" and leave the writing style alone. That way, you'll get along fine with the writer.

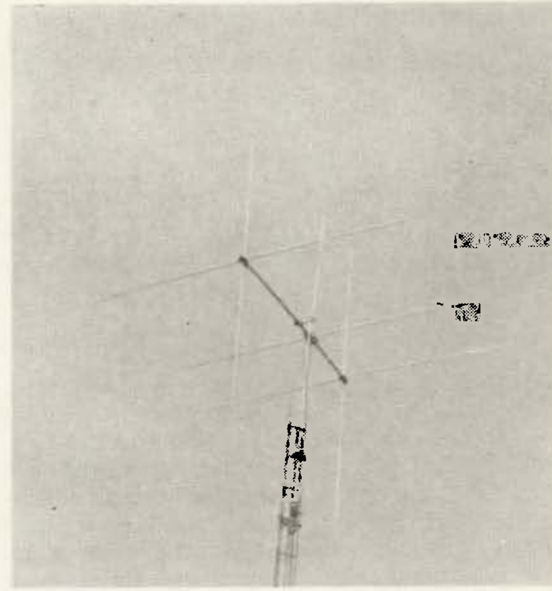
And as a final word, don't try to work the newsmen to death. About one good story every three months or so is all any one medium can take on any subject. Editors have long memories, and if you call much oftener than that you'll get the reputation of being a publicity hound—and that will be the end of your efforts.

Of course, he can take a public service story now, and a human interest yarn then, if they involve different hams. And any activity that ties in with other news stories—March of Dimes telethons, floods, brush fires, missing-persons searchers, etc.—is nearly always good for a news story on the ham angle alone. Just be sure to let him know right then—not a week later.

For in the news business, there's a saying: "There's nothing deader than yesterday's story." When you're involved in something timely, take a minute to call the editor and let him know. Otherwise, let him know in advance. That way, you'll tell the world.

K5JKX/6

NEW from Space-Raider



Hailed by HF men as a major break through in antenna design and performance, the famous K6CT polarized diversity beam, based on the proven principles of the Yagi parasitic array and Brown turnstile antennas, and using the rugged plumbers delight construction.

Minimizes QSB due to polarization shift, increases forward gain 50%, F/B ratio by 70% and side rejection to a level heretofore considered impossible.

After one year of rigorous tests under all conditions, proving the validity of design concept, its superior performance is now well known to the DX fraternity on 10 meters.

Space-Raider is pleased to announce the first of a new family of beam antennas, which was the DX contest winner in W6 land in October of 1960 and also is consistently reported as the first in and last out and many times the only U.S.A. signal readable. For comments at the other end; ask about this antenna of VK6QL (78 QSO's), ZL2UD (44 QSO's), LU1DAB (15 QSO's) and KA2EB.

The new Space-Raider Polarized Diversity Beams are all-aluminum construction of course, including all elements, boom, support mast, hardware and matching section.

Boom and mast material used in Space-Raider beams is of 6063-T-6 alloy which together with the elements carries the A rating in the standard scale of corrosion resistance thereby insuring maximum resistance to corrosion. Aluminum hardware is of high strength Aircraft Alloy. Bolts and nuts are steel 5/16 Standard hex and are especially plated to resist corrosion.

NO COMPROMISE has been made with quality and ruggedness in producing these fine light weight heavy-duty antennas.

10 METER BAND

Model	Specifications	Amateur Net	Weight
B-10-66	K6CT Polarized Diversity Beam, 6 element. 1¼" O.D. Center Sections; 1" O.D. & ¾" O.D. adjustable end sections. Boom: 2" O.D. 15" long. .125 .19 Spacing Forward gain 12 D.B. Front/Back ratio; 44 D.B.	$70.00	32 lbs.

15 METER BAND

Model	Specifications	Amateur Net	Weight
B-15-6	K6CT Polarized Diversity Beam, 6 element. 1¼" O.D. Center Sections; 1" O.D. & ¾" O.D. adjustable end sections. Boom: 2" O.D. 15' long. 125. 19 Spacing. Forward gain 12 D.B. Front/Back ratio; 44 D.B.	$70.00	32 lbs.

20 METER BAND

Model	Specifications	Amateur Net	Weight
B-20-6	K6CT Polarized Diversity Beam, 6 element. 1¼" O.D. Center Sections; 1" O.D. & ¾" O.D. adjustable end sections. Boom: 2" O.D. 24' long. .125 .19 Spacing. Forward gain 12 D.B. Front/Back ratio; 44 D.B.	$114.50	44 lbs.

6 METER BAND

B-6-12 COMING SOON

Direct inquiries to:

Space-Raider
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An Argument for a New Type of Radio Communication

Zero-Shift Keying

Jim Kyle K5JKX/6

ARE you an experimenter, looking for the opportunity to pioneer new fields? Then maybe this article is for you.

Let's admit right off that it's theoretical; although it includes several schematics, none of the equipment has been built or tested—which means that the system may have a number of hidden bugs. However, all the component parts of the system have been used in other branches of electronics with success—and there's no apparent reason why they won't do as well here.

Even if the entire system had been built, it couldn't be tested on the air (except at microwave frequencies, which offer their own problems) under present regulations—which means that if it works for us in our bench test, we'll have to petition the FCC for permission to use this type of modulation on the more-popular ham bands.

But, if it works, getting permission to use it should pose no problem, because the gadget is a high-speed RTTY system requiring virtually zero bandwidth. It's also almost impervious to interference, noise, or other disturbances, and utilizes present equipment with less modification than is necessary with present-day RTTY gear. Only one attachment is necessary at the transmitter, containing a single stage, and another at the receiver.

The entire system is based on the fact that RTTY is basically a binary pulse-code modulation system, in which groups of five pulses convey each letter. Most RTTY activity today uses frequency-shift keying, in which one frequency is transmitted to indicate the presence of a pulse and another frequency is sent to indicate pulse absence. These are known as the "mark" and "space" frequencies.

Commonly, mark and space frequencies are separated by 850 cycles (the value is a carry-over from landline teletype operation) although regulations allow us to use any shift between 0 and 850 cycles.

Now, let's back off a minute and look at the situation from the viewpoint of a digital computer engineer. His hardware operates with strings of binary pulses which are either there or aren't there, too. Instead of mark and space, he calls them "one" and "zero", but it's the same situation. To him, a teletype transmission is simply a chain of 5-bit pulse trains.

One of the larger problems facing computermen today is that of transmitting data from one computer to another cross country, and they've put a lot of study into it. They've analyzed almost every possible form of modulation from the standpoint of easy separation of "ones" and "zeroes", and the system we're describing is based on this study.

Take a flow of direct current. Its polarity may be either positive or negative. This provides a binary representation, which in fact has been used in the trans-Atlantic cable.

However, it's difficult to transmit dc over the air, so let's turn our attention to a sine wave. It, also, may be either positive or negative. That is, the sine wave may be either in phase with a known reference, or 180 degrees out of phase with the reference. This, too, provides a binary representation.

In other words, "mark" can be represented by an rf sine wave of any desired frequency and "space" would then be a sine wave of the same frequency but 180 degrees opposed in phase. Since frequency would remain unchanged, bandwidth of the system would approach zero (actually, in FM terms the signal would have infinite bandwidth every time the phase changed and zero bandwidth in between. However, energy content at any one frequency of a signal of finite power spread over an infinite band is infinitesimal and can be ignored).

To accomplish this in an actual transmitter,

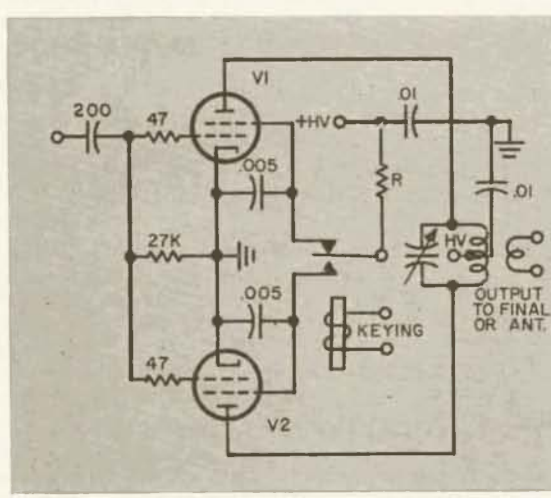

Fig. 1

the keying unit shown in Fig. 1 could be inserted at any stage operating at the output frequency, preferably just before the final.

This unit is a balanced modulator such as is used in sideband, but it's fed from a dc source. The tubes conduct only if their screens are connected to positive voltage. Relay K1 assures that only one conducts at a time. If V1 is conducting, the output phase will be 180 degrees away from that of the input, while if V2 is conducting, the phase will be unchanged. Thus keying the relay changes phase of the output signal by 180 degrees.

At this point, we have a signal going out which contains all our information in zero bandwidth, but we have no way of detecting it. That's what we need to examine next.

Figure 2 shows a typical phase detector which compares the incoming signal to a reference and gives one polarity output if incoming and reference signals are in phase and the opposite polarity if they are 180 degrees opposed. With such a detector at the end of the receiver's *if* strip, we could use the polarity changes to operate either a sensitive polarized relay or a dc amplifier circuit to key the printer — if we had a stable reference source.

The best reference source is the incoming signal itself. If we double its frequency in a multiplier, the phase shifts will disappear. We can then use this as a reference voltage to phase-lock a frequency divider, ending up with a phase-stable reference voltage which is either in phase with the original reference or 180 degrees out. If it's 180 degrees out, the result will be the same as being tuned to the wrong side of zero-beat in a present FSK system, and the cure is also the same—switch to the other side using a reversing switch.

A complete unit fed from the grid of the receiver's final *if* stage is shown in Fig. 3. Power supply for the adapter is not shown, but a separate power supply should be built for it since most receivers can't stand being robbed of so much filament current as the adapter would require.

In addition to the saving in spectrum space achieved by going to zero bandwidth, this system would be much easier to tune than the

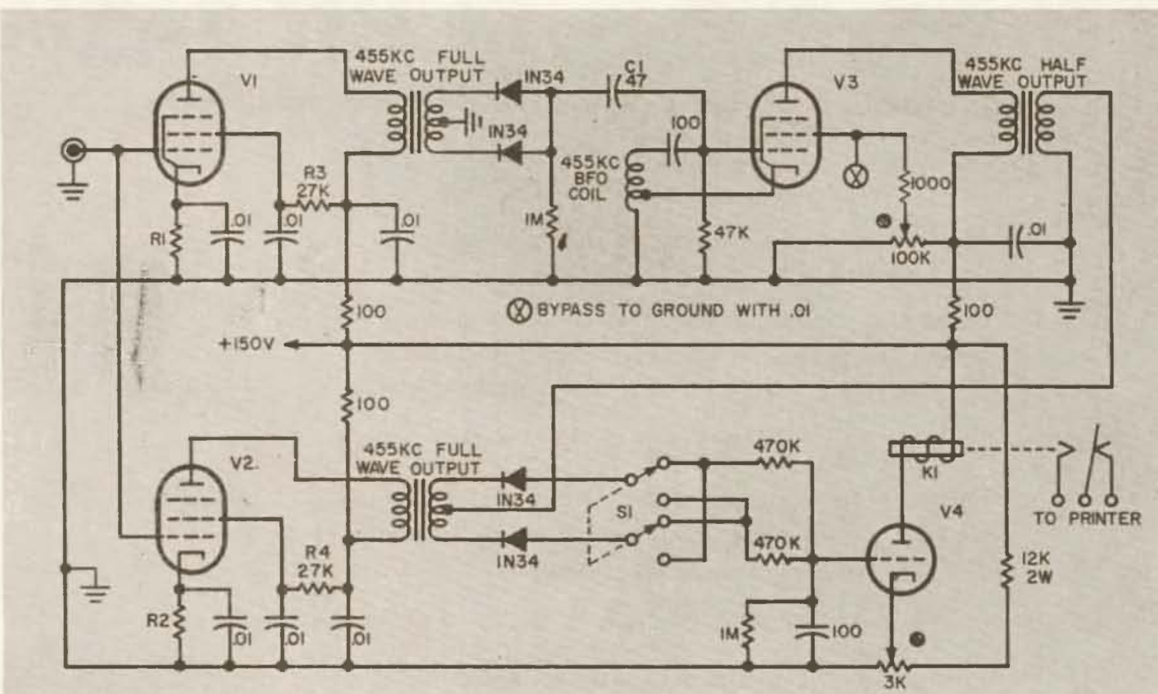

Figure 3. Zero-shift RTTY Reeceiving Adapter, Schematic Diagram. All transformers are replacement-grade 455-kc *if* transformers. Suitable units are made by Miller and by Stancor, among others. V1 and V2 are isolation amplifiers; the input connection is to be taken from the grid of the receiver's final *if* tube. V1 feeds a full-wave frequency doubler, which removes phase information from the incoming signal and then, through C1, synchronizes reference oscillator V3 in perfect phase with the incoming carrier. If the value of C1, R1, and R3 is correct, when the receiver is tuned to an AM station and the output of V3 temporarily coupled back to the regular detector, the beat note will jump to an absolute lock (thereby disappearing) as it reaches 2 to 3 kc. V2 feeds the incoming signal directly to the phase detector, where it is compared in phase with the reference derived in V3. Switch S1 corrects for the possible 180° mis-phased condition which is analagous to being tuned to the wrong side of zero beat in conventional FSK. V4 is a relay-driver stage. The 100K pot in the screen of V3 adjusts strength of the reference voltage with respect to incoming-signal voltage at the phase detector. The 3000-ohm pot in the cathode of V4 adjusts bias on V4 for proper on-time-off-time conditions at the relay while receiving an "RY" series.

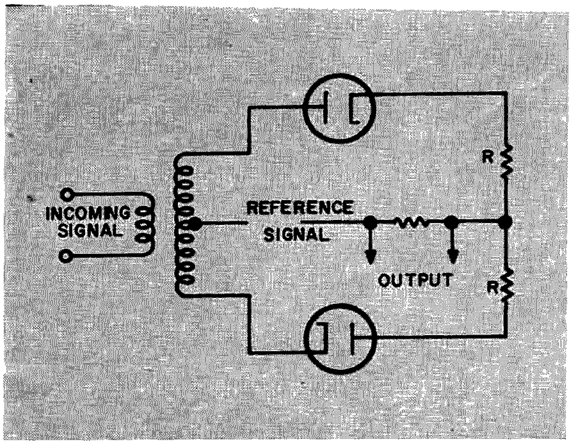

Fig. 2

present FSK technique. In the absence of a strong interference which might capture the phase-reference generator, the only requirement for a solid copy would be that the incoming signal be somewhere in the receiver passband. By using only the polarity of the received and detected signal as the indicator of information, slight phase shifts and beats caused by interference are made insignificant. Computermen report an average increase of 3 db in usable-signal-noise ratio as compared to FSK for this system; this means that the signal can be 3 db lower in the noise level for the same accuracy of copy.

The advantages have been listed, but there are a few disadvantages too. The largest is that this system is incompatible with present FSK RTTY. A station equipped only for zero-shift could not communicate with an FSK station, and vice versa. The situation is somewhat analogous with the wideband FM vs. AM, or AM vs. SSB, dilemma on the phone bands. In addition, as mentioned at the start, this is only a theoretical system in its application to RTTY and has not been tested at all. Hidden bugs might appear in widespread tryouts.

However, if you're an experimenter, looking for the opportunity to pioneer new fields, then maybe here's one for you. What do you think?

Diagram Clarification

Those little buttons near the pots in Fig. 3 are our cryptic way of indicating that they should be the screw-driver adjustable type and need not protrude from the panel for use. The top 1N34 in the V4 grid circuit is shown connected backward. This probably won't affect you since the likelihood of your building this circuit is rather remote. . . . K5JKX/6

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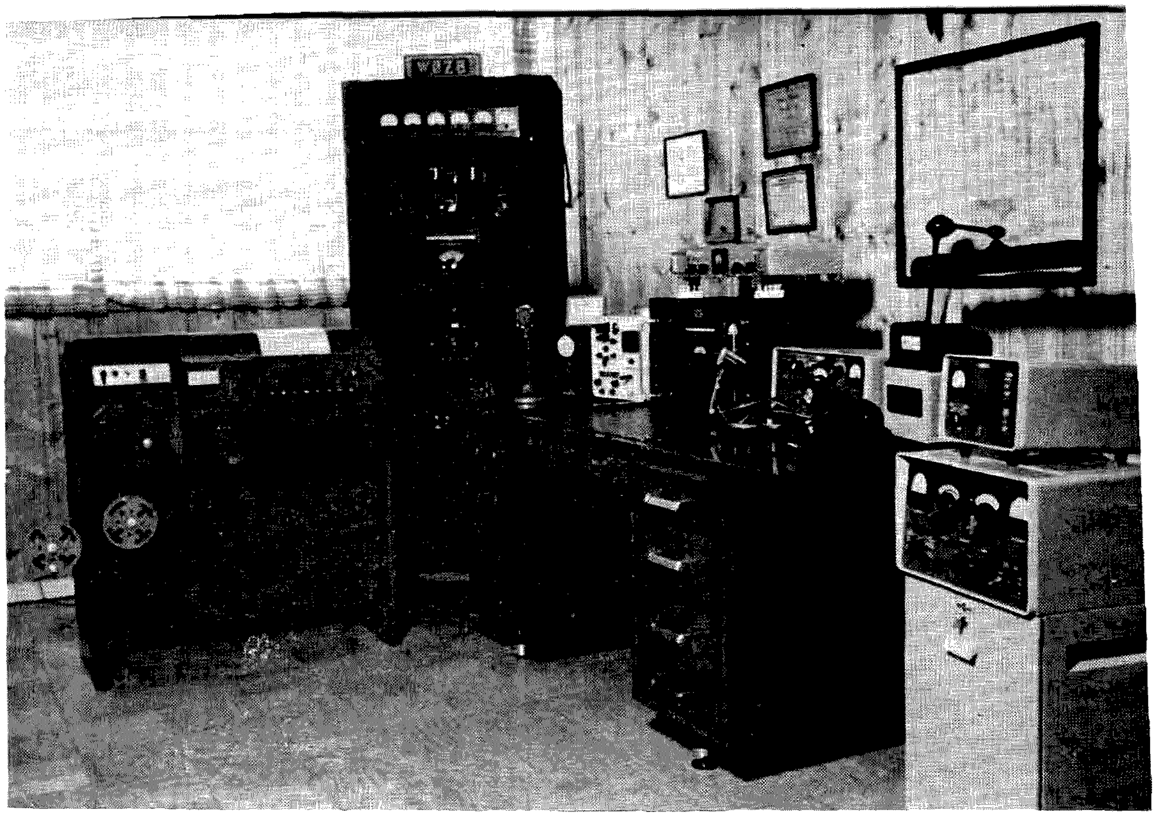

Typical 73 Subscriber Ham Shacks

Two of our RTTY ops sent in photos of their shacks, which you can see are quite normal. Les Benson, WØZB of St. Louis has a Model 28 Teletype, a KW-1, and a few minor items of Collins lineage. Ray Nuss W8KDW of Doylestown, Ohio has a couple Model 15's and a Model 14 Teletype, plus the Collins 51J4 and 32V3 into a HOMEMADE linear.

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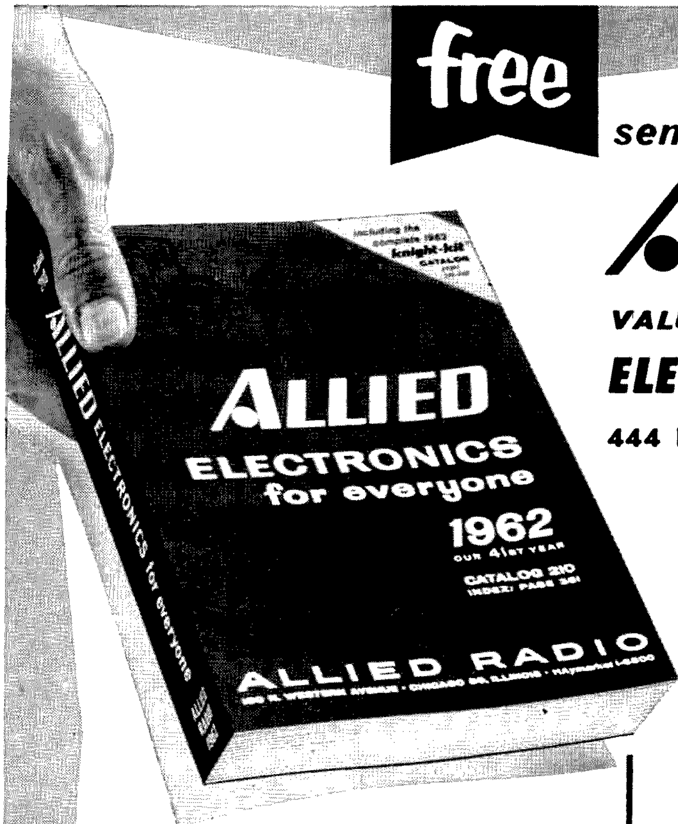

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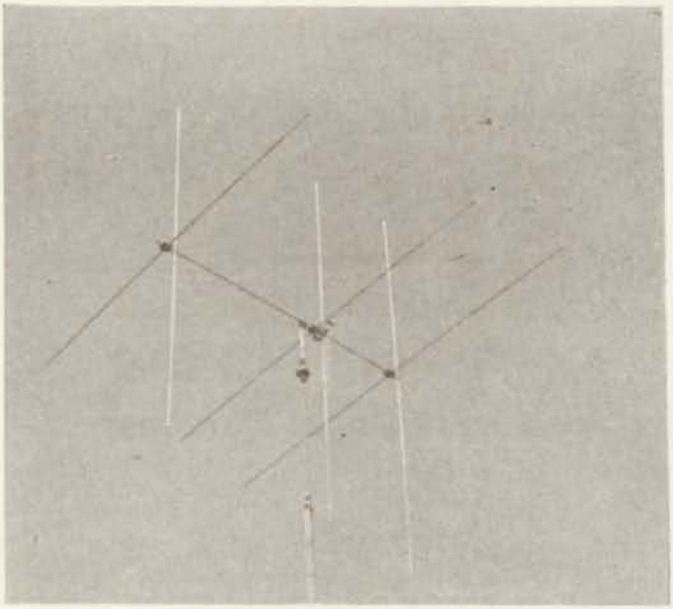

A new antenna design concept

George Messenger K6CT
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West Covina, California

Polarization Diversity

QSB appears to be one of the worst factors in reducing the readability of signals. W6ZGC and I checked the 10 meter band for a 12-month period during 1958 and 1959, Using dual installations, one having a horizontally polarized antenna and the other vertical, and found that *QSB due to polarization shift caused about 80 percent of the total of QSB present in received signals.* The 20 percent balance consisted of QSB caused by the signal swinging in azimuth, over or under jumping. and polar flutter. An antenna system capable of receiving in both planes simultaneously was obviously worth working on.

The usual method of getting diverrity reception is to use two separate antennas, spaced well apart, and feed them into two receivers. Obviously this arrangement was not for ham radio. We wanted to work up something that was simpler and generally usable without a lot of expense or dither. We wanted to solve the problem the "ham" way, not the commercial way.

I will gloss quickly over all of the mistakes we made along the way and cut short the suspense. Since you are reading an article you will not be surprised to know that we solved the problem rather neatly. The result is a six element Yagi, with three elements vertically polarized and three horizontally polarized. It is fed with 52 ohm coax, permitting me to keep the low-pass filter in the line (and me in the neighborhood). The Brown Turnstile feed system was chosen, being real simple.

The project evolved along normal ham lines. Lacking a tower for preliminary tests we put it up as best we could and rigged up horizontal and vertical field strength meters. Even though it was so low that passing cars made the SWR meter jump like a radar speed meter we found that signal reports were already unbelievable. This tempered the home climate a bit and I "gave" my wife a tower for her birthday, pointing out that this was a small enough sacrifice for science and besides that was the only money I had.

Once we had it up on her tower the signal reports were even more incredible. Running only 135 watts to a Viking II I polished off the following Q5-S9 contacts consecutively: CX1VD, LU1NH, ZS3L, ZS6AST, ZE7JV, JA3AVD, JA1BYM, LU3ACA, W1NCX, ZL1LY, VKøWH, and ZL3BL. On all contacts I checked the new beam against my quad, operating at the same height above ground, and found that the signal was always much higher on the new beam. The average difference ran from 3 to 5 db above the quad! Stations, one after the other, reported that my signals didn't have the QSB they were hearing on all other signals.

Many an operator has thought his station to be outstanding, only to be crushed during a DX contest. I battled through the 1960 CQ WW DX test and racked up 8190 points on 10 phone. The next highest score was old contester W6NAT with 4026 points. I had more than doubled the score of the runner-up in the sixth district, which you'll have to admit is the toughest there is. The final results aren't in

for the 1961 ARRL DX test, but I managed 8280 points on 10 phone.

In normal operating you notice the difference in that stations almost invariably come back to you when you call. They all report a lack of QSB on the signal. They usually mention that I have the loudest signal from my area and that my signals are the first in and the last out. Many report calling me for an hour or so before their signals were able to come through in the opposite direction.

After much testing we have measured the front-to-back ratio as 46 db and the front-to-side as 66 db. Since this is regardless of incoming polarization it is phenomenal to use.

As more and more stations became aware of what was going on I got more insistently peppered with questions about the beam. As KR6CR said, "Please send the dope . . . all the talk out here is about your antenna. You come through from Stateside when we don't hear anyone else."

Though you can probably duplicate my beam pretty well from a look at the not too clear photo in this article, I'll be along with the details for you in Part II next month. If you can't wait (ahem, here comes the commercial) then you might check the obscure little ad on page 41. . . . K6CT

Letter

Dear Wayne:

Just mailed in my renewal to "73." That ought to shake u up. I was looking for a low powered 2 meter transmitter. I read your article on page 34 of April "73," and bought the Heath Twoer. I had no trouble with the construction or alignment. I made a simple modification and now I have a 4 watt 2 meter base transmitter and a 2 meter portable rig.

Parts required: 1 phono plug; 6 inches of wire. Install the phono plug on the rear apron between the fuse holder and the regeneration control, run the six inch wire from the phono plug to contact number 10 of the rotary switch (Z). This brings the antenna out to the newly installed phono plug. I feed this into my "International 2 Meter Crystal Converter" and into my Hallicrafters SX101. The 6BS8 preamp. detector must be removed from the Twoer or the radiation from the oscillating detector will block the receiver.

Martin Rexsen W2FEI

SX-101A

In the S meter circuit of the SX-101A the 6BA6 tube can be replaced by a 5749, which proves to be much better. This will add up to 10 or 15 DB's more on each S meter reading. Nothing has to be done to the receiver since these tubes are interchangeable. Since this tube makes the meter more sensitive, the S meter must be re-adjusted a little. This tube will make for truer signal reports.

Jeff Gilbert WA2NYO

Staff

Crystal Oscillators

OSCILLATORS are important gadgets to us hams. Even aside from their uses in receivers, the ever-present oscillator is a necessity for any transmitter. For CW use, the entire transmitter might be made up of an oscillator and a power supply—and in any other rig, at least one oscillator must be included to generate the carrier frequency.

Since the oscillator *is* such an important device, it has undergone thorough study by many researchers. As a result, literally hundreds of oscillator circuits have been published. Choosing the best circuit for your own use from this mass of material becomes difficult, and many otherwise worthwhile circuits have become almost lost simply because not enough people have learned about them.

We're going to explore the entire subject of vacuum-tube oscillators, including several circuits which haven't seen much use as well as some of the old standards of the field.

Since there are so many different circuits, though, we're going to divide the field between crystal-controlled oscillators and those oscillators whose frequency is continually adjustable (or, in other words, VFOs) and cover each part in a separate article. This article deals strictly with crystal oscillators.

The crystal of a crystal oscillator is a small plate of Brazilian quartz, ground to precise size and thickness. The physical dimensions of the rock determine its natural resonant frequencies. In the proper circuit, these natural resonance frequencies determine the frequency of operation of an electronic oscillator—and since the crystal's resonances are determined by physical means rather than electronic elements, the frequency remains much more stable than would otherwise be possible. Frequency stability as great as one part in ten billion (that's 0.00000001 percent) is possible with the proper crystal circuit and construction.

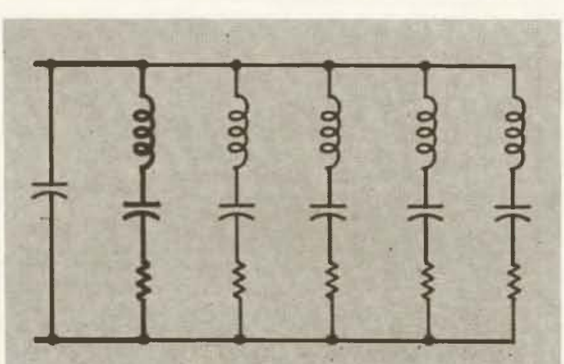

Fig. 1

You may have noticed that all through that last paragraph we were talking about the crystal's resonant frequenc*ies*, although only one frequency is marked on any commercial crystal. That was no mistake; all quartz crys-

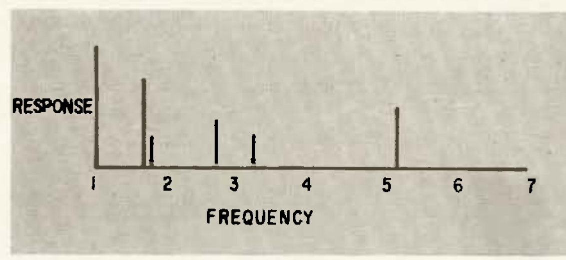

Fig. 2

tals exhibit multiple resonance. The marked frequency is the one at which the rock is intended to operate, but operation at any of the other resonances is usually possible. One of the best examples of multiple-resonance operation is the conventional overtone crystal, which operates at the third harmonic of the basic fundamental frequency through proper circuit design. Frequently, these crystals, may be coaxed into operation at other overtones as well.

One way of grasping the idea of a crystal's operation is to examine its equivalent circuit, shown in Fig. 1. This is what a crystal looks like, electrically, to the circuit. You can see that the several series-resonant circuits also form parallel-resonant circuits at other frequencies. This multiple-resonance quality of a crystal is shown in Fig. 2 as a frequency spectrum for a typical unit.

At this point, let's concentrate on just one of the series circuits shown in Fig. 1—the one shown in heavier lines. This is the primary resonance of the crystal, the one at which it will oscillate or transmit most readily. It's drawn separately in Fig. 3, along with the shunt capacitance of the electrodes which make

contact with the two sides of the rock itself.

You can easily see that at one frequency, C1 will be almost a short-circuit which leaves only a parallel-resonant tank circuit, while at some other frequency Ch will be almost an open circuit which leaves only a series-resonant arrangement. In practice, these two frequencies are usually within a very few kc of each other, which leads to the crystal impedance curve shown in Fig. 4.

It's important to remember that every crystal has both series-and parallel-resonance at its primary frequency; at its other resonant frequencies this way not be so, since the effective values of inductance and capacitance may be so far different. However, in fundamental-frequency operation some circuits use series resonance and others employ the parallel or antiresonant condition. This makes the same rock operate at two slightly different frequencies, depending on which type of circuit it's used in.

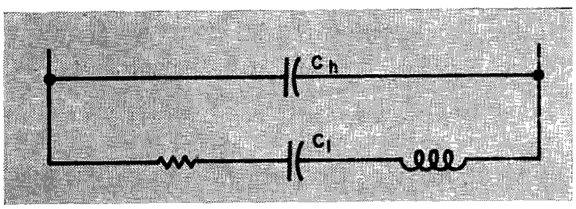

Fig. 3

In addition, external circuit capacitance or inductance will also reflect back into the equivalent circuit of Fig. 3, which causes slight changes of frequency with changes of external elements.

This can bs used as an aid to getting precise spot-frequency results, especially at VHF, by connecting a trimmer capacitor across a crystal which is operating in parallel mode or in series with a series-mode crystal; however, it can also be a hindrance if you don't make allowance for it in building any equipment which will use a crystal oscillator.

Enough about the crystal itself; let's look at some practical circuits.

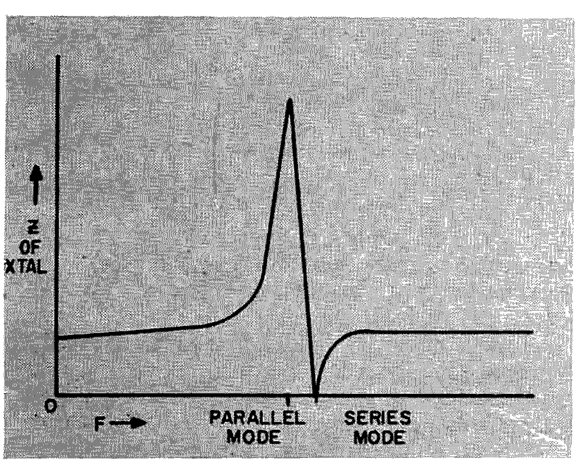

Fig. 4

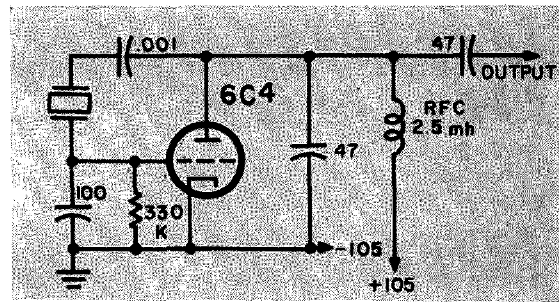

Fig. 5

One of the simplest of all crystal oscillator circuits is the Pierce, shown in Fig. 5. While this circuit, at first glance, looks as if it would use series-resonance to feed back energy from the plate circuit to the grid and cause oscillation, such is not the case. It actually uses the parallel resonance of the crystal to establish a rather complicated network from plate to grid circuits.

Because of its simplicity, many hams appear to have the feeling that the ancient Pierce oscillator can't be very good. Actually, it is as stable as any other crystal oscillator circuit in general use. Its only major disadvantage (shared by many other circuits) is that it's easy to overdrive the crystal and damage it. For best results, any crystal oscillator should be run at minimum power input. Its purpose is strictly to establish the frequency; power buildup should be reserved to later stages. If the Pierce is used in this manner, its performance is equal to any normal crystal oscillator.

Advantages of the circuit are its simplicity and its versatility; this is the only common oscillator circuit which requires no readjustment at all when changing frequency, regardless of the difference in frequencies. It will oscillate at the primary parallel resonance of any crystal put in the socket.

Another well-known fundamental-frequency oscillator is the Miller circuit of Fig. 6. It's

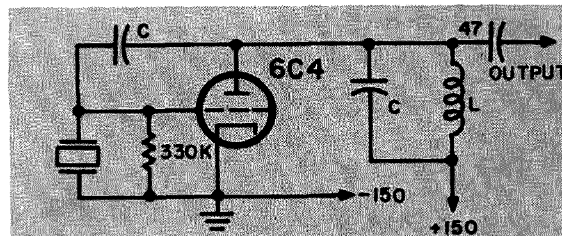

Fig. 6

almost as simple as the Pierce, especially since capacitance C is usually furnished by the tube's internal capacity. Like the Pierce, it provides output only if a crystal is present, but unlike the Pierce it requires a fairly critical adjustment of the plate inductance whenever frequency is changed.

If you don't mind an additional knob to twist at tuneup time, this is no disadvantage, but

it does introduce some slight shift of frequency from that stamped on the crystal holder. If you're not multiplying you'll never notice it, but if the Miller circuit is used at the fundamental for multiplication to VHF, you can almost use the plate tuning adjustment to make the oscillator's frequency variable over an effective 100-kc range!

Crystal dissipation in the Miller circuit is considerably lower than in the Pierce, since the rock gets only the grid voltage across it (in the Pierce, full output voltage was impressed across the crystal terminals). In practice, this means that a Miller circuit can be used to develop enough power to drive the next stage without harming the crystal—an important point when building portable or mobile equipment. However, frequency stability is not as good as that of the Pierce circuit, because any changes in tube characteristics during use are reflected back to the crystal.

Both the Miller and the Pierce circuits make use of parallel resonance; let's look at some of the series-resonance circuits. Before we do, though, let's investigate this business of overtone oscillators a bit.

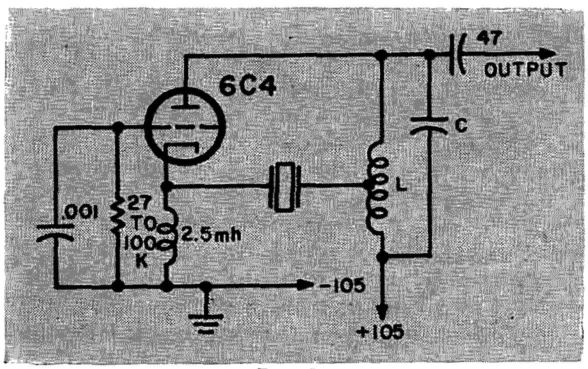

Fig. 7

Earlier, we pointed out that every crystal has a number of resonances. Some of these resonances are located near the third, fifth, seventh, and higher odd-order harmonics of the primary resonance. Notice that we said *near*, not *at*, because they're never located at exact multiples of the primary resonance. The most active of these resonances are the parallel mode at the third harmonic and the series modes at the fifth and seventh overtones.

Since the growth of interest in VHF, there's been considerable interest in "overtone oscillator" circuits. A number of circuits have been developed primarily for this use—but there's nothing about these circuits which would stamp them overtone circuits. Most of them are merely series-mode circuits with the resonant circuits tuned to the appropriate overtone.

"Overtone crystals" are especially processed to yield higher output on a selected higher-order resonance, but the greatest advantage to the use of special overtone crystals is that they are calibrated at the operating overtone frequency. For example, a 10-mc rock may be operated at its fifth overtone, and the out-

put will be somewhere near 50 mc. A fifth-overtone 50-mc crystal, on the other hand, will give output right at 50 mc but if operated at its fundamental will only be somewhere near 10 mc.

Now, back to the series-mode circuits. Remember, they operate at the fundamental or the fifth or seventh overtones equally well, depending entirely on circuit constants.

One of the simplest series-mode circuits was developed by Butler and is described in Edson's "Vacuum Tube Oscillators" as "The Grounded-Grid Circuit." It's shown in Fig. 7.

In operation, output of the tube is fed from the plate back to the cathode at the crystal's series-resonant frequencies. Just which frequency is effective is determined by the tuning of the LC circuit.

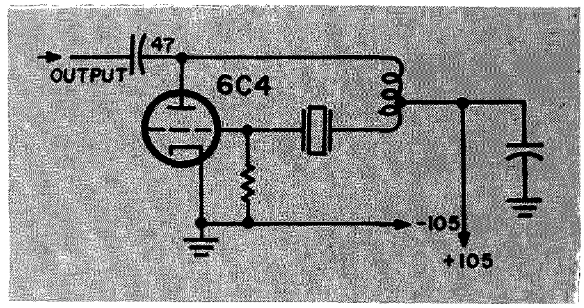

Fig. 8

This circuit will work well with most any crystal, since the input impedance of the tube's cathode is low. This means any current which gets through the crystal will go into the cathode circuit rather than to ground. If tube gain is great enough, the crystal can be extremely sluggish yet still provide good input.

A similar circuit was described several years ago by W8CBM, who called it a "grounded cathode Hartley." His version is shown in Fig. 8. The major difference is that the tube is fed at the grid rather than at the cathode, and consequently fewer parts are required.

Either of these circuits will oscillate on its own if the tap is too high on the coil; to determine if the circuit is under control of the crystal, touch the crystal terminal with a screwdriver while listening to the output signal on a receiver. If the crystal is controlling the signal, frequency shift will be extremely small—possibly even so little that you can't tell it. If the oscillator is taking off on its

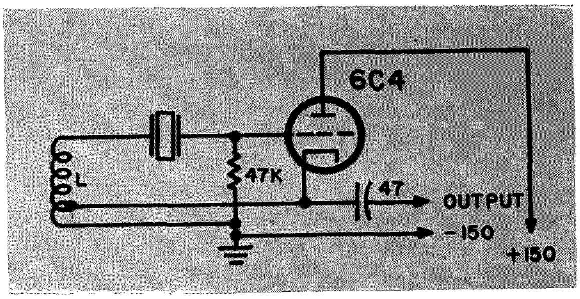

Fig. 9

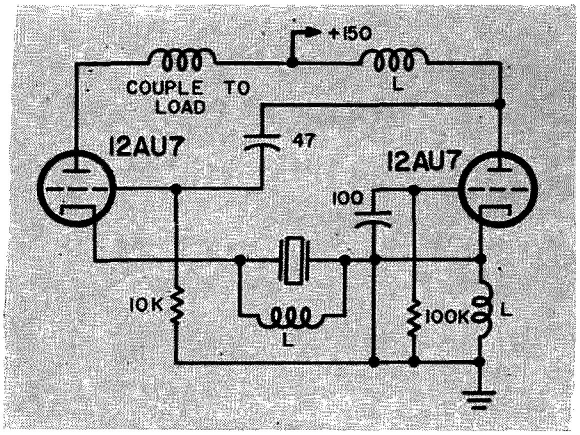

Fig. 10

own, the signal will jump out of the receiver passband with this test.

Still a third version of this circuit has been developed in the 73 labs in connection with a low-plate-voltage converter which refused to operate properly with conventional crystal oscillator circuits. It's shown in Fig. 9. The difference here is simply in the cathode return circuit; frequency is still determined by the crystal's series resonance.

If you're familiar with the Hartley VFO, you'll recognize the preceding three circuits as the Hartley, with ground returns for rf made at the grid, cathode, and plate respectively. Each has its own advantages and disadvantages for specific applications, but in general there's little to choose from between the three. For instance, only the circuit of Fig. 9 is suitable for mixer use, since it's the only one having the plate at rf ground. On the other hand, the circuit in Fig. 8 is least susceptible to hum modulation from the tube's heater, since the cathode is grounded for both rf and dc.

Another series-mode circuit widely used for

(Turn page)

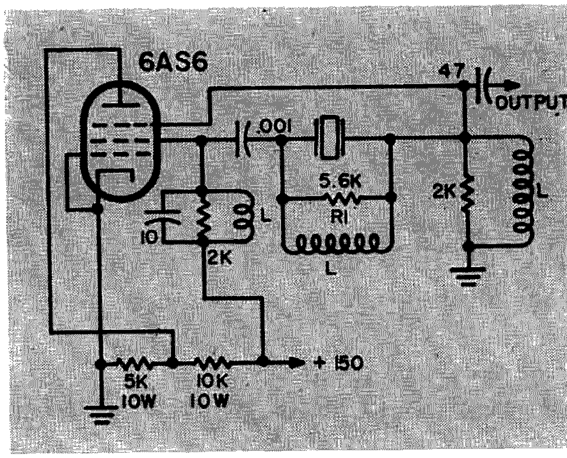

Fig. 11

overtone applications is that shown in Fig. 10. It's known as the cathode-coupled oscillator.

This circuit, though it uses two tubes instead of one, offers almost complete isolation between the crystal itself and the load circuit. In addition, it is capable of considerably more power output than other series-mode circuits.

However, the circuit does not perform well with low-resistance crystals, and in most situations a single-tube oscillator followed by a buffer amplifier will outperform the cathode-coupled circuit in both the power-output and frequency stability departments, according to Edson.

A series-mode circuit especially suited for use with high-impedance (or sluggish) crystals is shown in Fig. 11. Originally described in a 1938 German publication by K. Heegner, it is also shown in Edson's book (which is the virtually complete work on all types of oscillators).

Edson calls the circuit the Transitron, because it operates in a manner similar to the Transitron VFO. If you remove the crystal from the circuit and replace it with a capacitor of value equal to the crystal's shunt capacity, you'll have a Transitron. However, because the resistances are chosen for crystal-only operation, the circuit won't oscillate.

When the crystal is replaced, the circuit is unchanged except at the crystal's series-mode resonant frequencies. At one of the frequencies (which one is determined by tuning of the LC circuits, which are not critical) R1 will be shunted by the crystal's internal resistance, which is much lower. This upsets the non-oscillation balance originally established without the crystal, and the circuit takes off at the crystal frequency.

The Transitron is good up to 160 mc, allowing direct crystal control on 144 mc. No other widely known crystal circuit is capable of operation at such high overtones.

However, a relatively unknown circuit called the capacitance-bridge oscillator can go as high as 219 mc, using the *73rd* (no pun intended!) overtone of a 3 mc crystal.

You have to pay a price for this extra-high

operating frequency; the version of the capacitance-bridge oscillator which gets to this astronomical (for crystals) frequency requires not one but three tubes for operation. However, it should be a natural for 220-mc converter use to avoid birdies. The circuit is shown in Fig. 12.

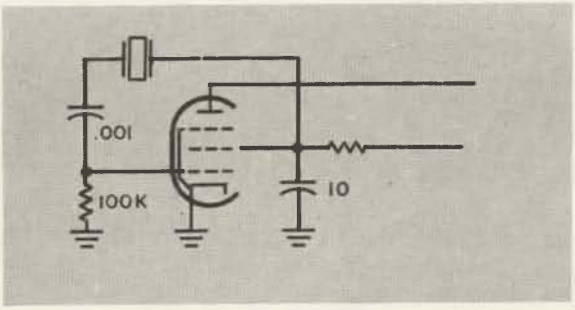

Fig. 12

Here's how it works: The bridge containing the crystal is initially balanced by adjusting C3, with C2 and C1 tuned well away from the desired operating frequency. This eliminates all feedback through the crystal shunt capacity. Then, C1 and C2 are tuned to the approximate frequency desired. The two-stage amplifier circuit then has high gain at this frequency, and since phase shift around the complete loop is 360 degrees the circuit will oscillate if any energy is fed back.

However, the only route through which feedback energy can travel is through the crystal, and this route is open only at a series-resonant frequency. As a result, the circuit oscillates at the nearest series resonance of the crystal. With a high enough fundamental-frequency crystal, the series resonances will be spaced widely enough that you will have no doubt as to the operating frequency.

This circuit requires complete shielding between stages, and long insulated shafts on all capacitors to eliminate unbalance caused by hand capacity. To achieve operation in the

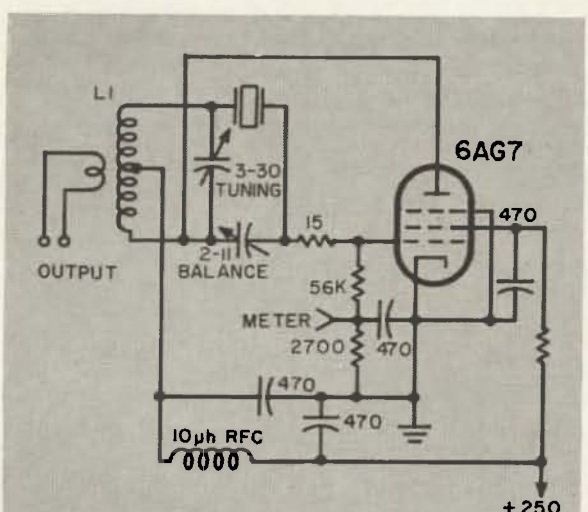

Fig. 13

200-mc region, the push-pull portion must be accurately balanced both in the bridge and in the amplifier, and leads must be short. The oscillator is also rather more voltage-sensitive than most, so plate supply voltages should be regulated with VR tubes.

At lower frequencies, the capacitance-bridge circuit makes possible construction of an overtone power oscillator which is crystal controlled. Stability is poorer than in other circuits, but for compact portable or mobile equipment operating on 6 or 2 meters the advantages of getting a full watt output from a single-tube oscillator stage more than outweigh lowered frequency stability—particularly when the stability is still greater than most VFO circuits achieve.

The circuit for the high-output oscillator is shown in Fig. 13. Measured output from this one is one watt of rf at 50 mc, operating on the 5th overtone of a 10-mc crystal, and ⅓ watt output at 80 mc. The circuit output falls off rapidly above 80 mc, primarily because of the large physical size of the 6AG7 tube. Substitution of a 6CL6 or a 6AH6, possibly with some change in circuit constants, would probably raise its upper frequency limit nearer the 2-meter band.

This oscillator drives the crystal too far beyond its rated limit, but researchers working with the circuit report that they have never damaged a crystal in this circuit despite the overload condition.

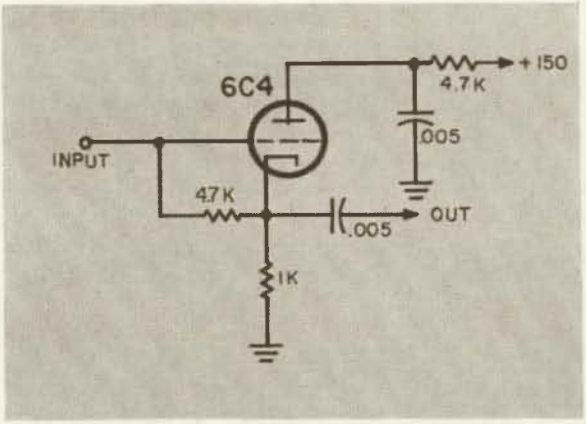

Fig. 14

Both these capacitance-bridge circuits are described more fully in a little-known government publication, "Handbook of Piezoelectric Crystals for Radio Equipment Designers," which is the result of an extensive Air Force-sponsored study of all possible crystal circuits. It's available from the Department of Commerce (see bibliography).

So far, we've been talking primarily about basic oscillators, in which output is taken directly from the oscillator circuit.

Usually, this isn't a good way to get the output, since it means that any variation in loading will be reflected back directly into the oscillating loop and may change the frequency. One way to isolate the oscillator from the load is to add a cathode-follower buffer amplifier, such as the circuit shown in Fig. 14. It connects directly to the point marked "output" in any of the other diagrams.

However, a simpler way of doing it if your oscillator circuit has its plate grounded for rf is to use an electron-coupled oscillator.

This circuit, which is applicable to any of the diagrams in which the plate is at rf ground, makes use of the screen grid of a pentode as the plate of a virtual triode. In other words, simple use the screen as the plate of the triode which is shown in the diagrams. Suppressor connection is normal, and

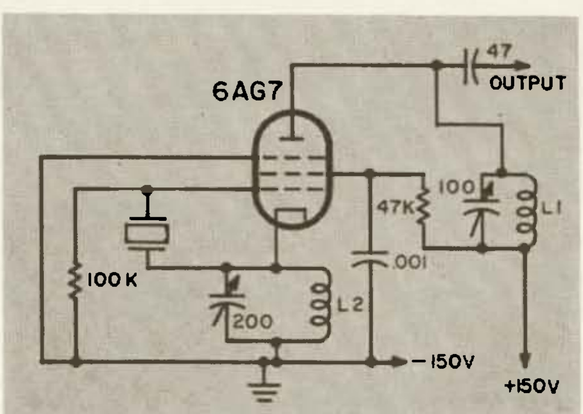

Fig. 15

tput is taken from the plate circuit by either ͻ or capacitor coupling.

In operation, the electron stream from cathe to the screen grid is carrying the oscillatg current, but the screen doesn't intercept l the oscillation current. What misses the reen flown on to the plate and from there the external load.

Since the load circuit and the oscillating op are coupled only by the electron beam om plate to cathode, the circuit is called elec-on-coupled.

In addition to the oscillators already disussed, several types of circuits are possible nly with the electron-coupled arrangement. uch a circuit is the "Tri-Tet" or electronoupled Miller circuit, shown in Fig. 15. This

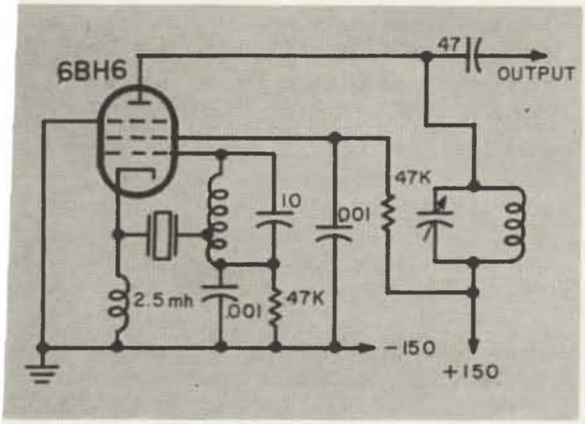

Fig. 16

circuit is capable of delivering a large power output with good frequency stability; its major drawbacks are that the plate circuit must never be tuned to the fundamental frequency of the crystal (too much feedback might damage the crystal) and that there are two controls instead of one to adjust when changing crystals.

Another electron-coupled circuit, described by Edson, is the series-mode grounded-plate oscillator shown in Fig. 16. Good operation is claimed, with "relatively large" power output at either fundamental or harmonic frequencies.

An excellent electron-coupled circuit which operates equally well at fundamental or harmonic frequencies is shown in Fig. 17. Originally described several years ago in a P-R Crystal advertisement, where it was dubbed the "grid-plate" oscillator, the circuit is also known as the Colpitts crystal oscillator.

The crystal is used in its parallel mode, at primary resonance. Feedback is established by capacitors C1 and C2. While either of them may be made adjustable, values shown in the diagram have proven satisfactory in practice. Almost any tube may be used; good results have been obtained with the 5763, the 6CL6, the 6AG7, and (in the non-electron-coupled version) the 12AU7, despite warnings that only the 6CL6 and 6AG7 were suitable for the

(Turn to page 61)

Radio Bookshop

Look over this list of books you should have and pick out one or two that you've been wanting. The way to have a good reference library is to build it up a little at a time. We pick over all the latest books carefully and list only those which are of real interest to amateurs. They're on hand ready to ship, postage paid.

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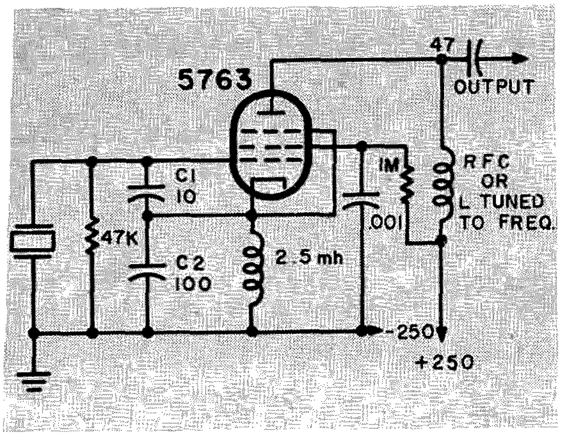

Fig. 17

rcuit.

Tuning of the output circuit is relatively ·oad; it needs only to be peaked at the center : the operating range. Since the output and ;cillating circuits are separated, output tun-ıg has almost no effect on frequency. This ıeans that, like the Pierce, no adjustment of ıe oscillator is necessary when changing rystals. In practice, this circuit has been ɔund to deliver approximately the same out-ut as a Tri-Tet when used with the same ubes and crystals, at a net saving of two djustments per crystal change, as well as al-ɔwing fundamental operation when desired.

Some circuits recommend by crystal manu-acturers haven't been discussed yet; these are ıll variations of circuits already shown. For nstance, International Crystal recommends he circuit shown in Fig. 18 for use with its 'undamental-type crystals. This is a Pierce ·lectron-coupled circuit, with capacitors added 'rom each side of the crystal to ground to naintain circuit capacitance at 32 mmfd (In-ernational's design value).

The same manufacturer recommends the ;ircuits of Fig. 19 and 20 for overtone use vith third- and higher-order crystals, respec-;ively. The third-order circuit is simply a basic Miller, while the higher-order oscillator is a ·ery slight modification of the Butler ground-·d-grid circuit.

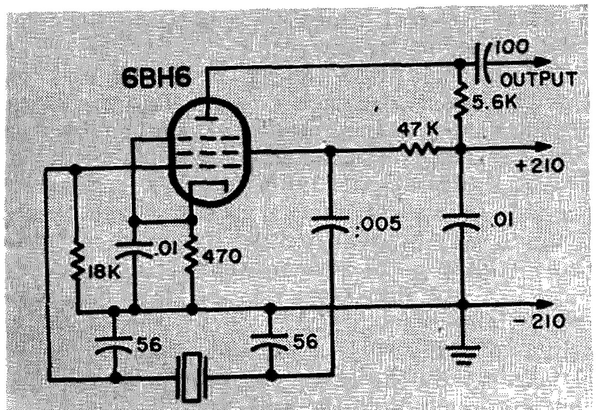

Fig. 18

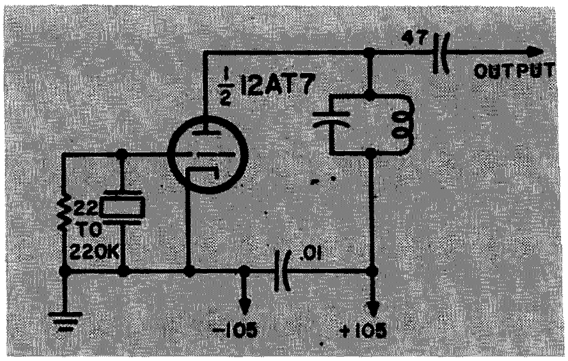

Fig. 19

All the crystal oscillator circuits described so far have one thing in common—they're single-frequency affairs. That is, they provide spot frequencies determined by the individual crystal in use rather than continuous coverage over a ham band. Continuous coverage, most people feel, is the province of the VFO; they reserve the crystal for spot frequencies where stability is important. However, the crystal oscillator *can* provide much of the flexibility of the VFO if properly used. One method has already been mentioned; this is the method of attaching a trimmer capacitor to the circuit to "bend" the crystal's frequency a little. The amount of variation obtainable depends both on the individual crystal and on the amount of frequency multiplication which follows the oscillator. For instance, W9KLR has used this trick to obtain 30 kc adjustable range on 2 meters, starting from a 4 mc crystal. A more extreme case is reported by W4KXI, who uses a special 8-mc crystal in a unique circuit to obtain a full megacycle of frequency swing on 144 mc. Details of the circuit are given in his article; it's too long to reproduce here.

Another approach to variable-frequency operation with crystals is the "frequency synthesizer," a device which uses a number of crystals (sometimes as many as 30) to obtain spot frequencies one kilocycle apart over all ham bands up to 50 or 144 mc. These devices work by mixing two crystal-controlled frequencies together, then selecting either the sum or difference as desired. Often the process is repeated several times to come up with the proper output frequency.

Like all multiple-mixing processes, use of a frequency synthesizer is subject to the bugs of spurious mixing products; they show up here as outputs at undesired frequencies in addition to the desired output. However, when properly designed, one of these gadgets can combine all the best features of both crystal and variable oscillators in a single unit.

Such a unit has been described by W2JKH (see bibliography) and others are also in print. All share the disadvantage of complexity; that's the price you pay for flexibility plus extereme stability and reset accuracy.

By combining both the frequency synthesizer and the "rubber crystal" trick, you can achieve

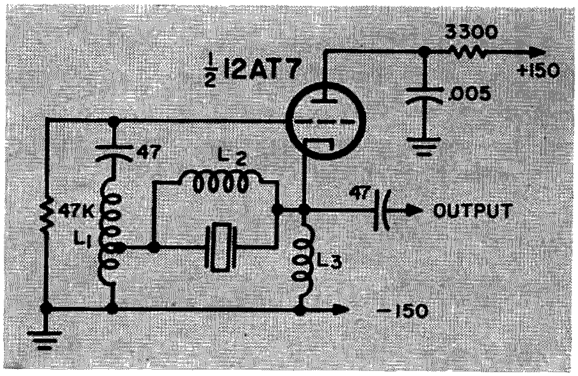

Fig. 20

complete coverage with no blind spots, on every ham band. However, at a slight sacrifice in stability and reset accuracy and an enormous gain in construction simplicity, you can do the same thing with a VFO—and that's the subject of our next technical article.

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Letter

Hi! Wayne:

Allright wise guy, what did you do with page 72 of the August issue? I desperately need that K2PMM KW to complete the portable rig I have in mind. It includes a minibox sized 75A4, 50 foot portable collapsible tower and new solar/terra (combining solar power with the plentiful ground currents) transistorized power supply. Publish it right away or I'll tell everyone that you secretly write articles for and subscribe to QST.

Wm Magee W2CDJ

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Sept. 10—Business Meeting

Sept. 17—Doing the job with photoelectrics.

Sept. 24—Communications receiver design.

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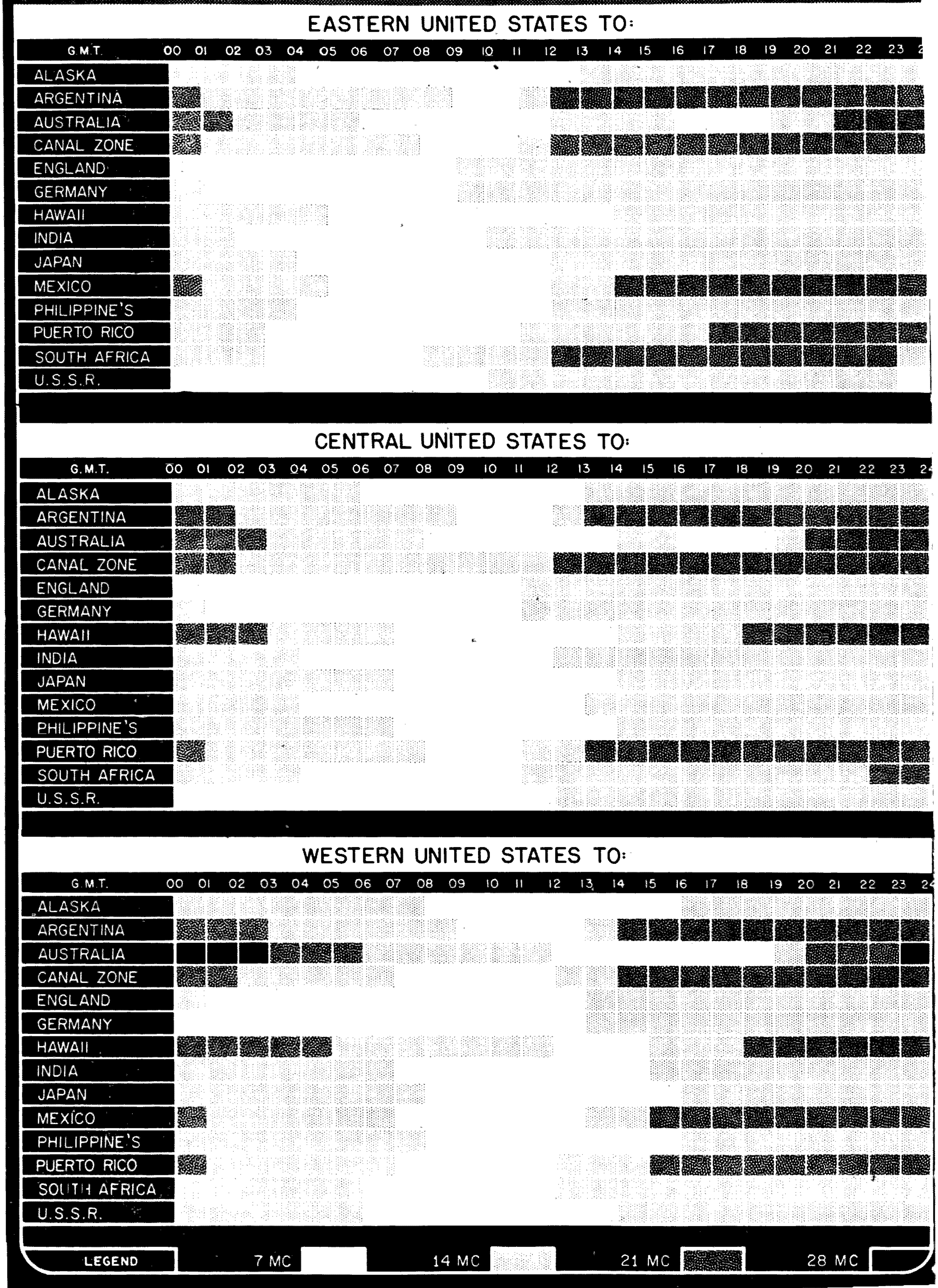
PROPAGATION CHART



Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

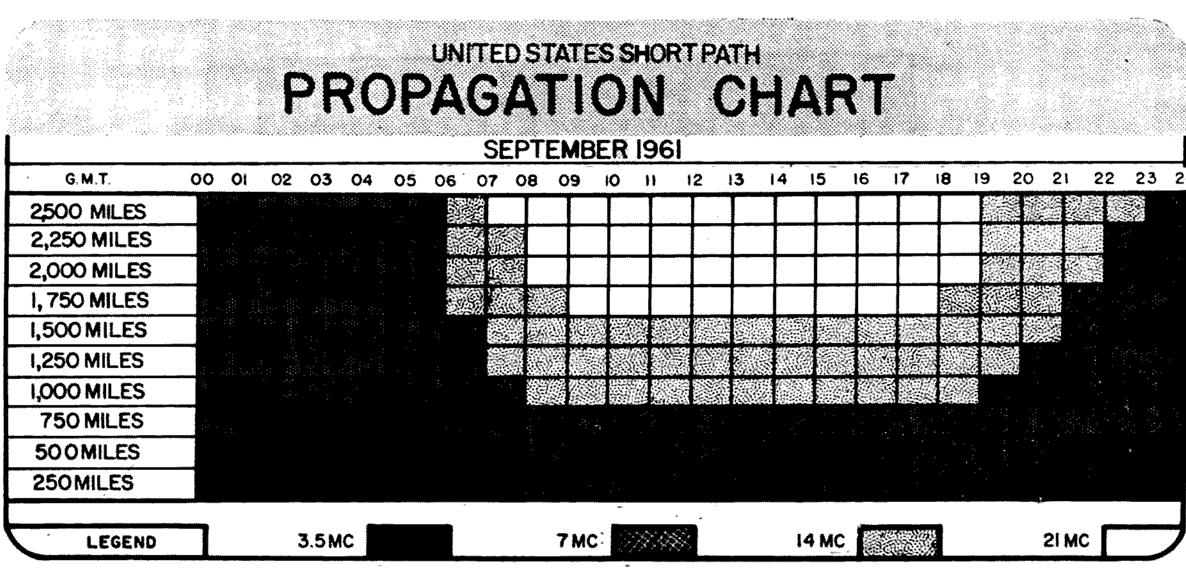
Advanced Forecast: September 1961

Good: 6-20

Fair: 4-5, 21-24, 27-29

Bad: 1-3, 25-26, 30

The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earth's curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HGF's next to the 1250 mile listings will give the HBF to use and the time periods given will be the same at each end of the circuit. B.) To work the path New York to San Francisco (2,600 miles), the local time centered on the mid-point of the path will be 1½ hours later than at San Francisco and 1½ hours earlier than in New York (the time difference between New York and San Francisco is 3 hours). Looking up the HBF's next to the 2,500 mile listings will give the HBF to use. In San Francisco subtract 1½ hours from the time periods listed for local time and in New York add 1½ hours to the time periods listed for local time.



Ham Headlines

If ham radio makes the newspapers in your town please send a clipping to Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Marvin runs the 73 News Service, a monthly publication sent to all editors of club bulletins. He will digest the most important stories that are submitted each month for us to print in 73.

HAMS HELP BLIND PEOPLE

(Toronto Daily Star.) When a group of 30 blind people began to look farther afield for more chess competition, VE3TC and VE3AEO came to the rescue. Both hams provided communications for the sightless players who are members of the Canadian Institute For The Blind Chess Club. It was hoped that the first 73 move game would provide inspiration for other hams to take up the call and lend their radio time to other CNIB players.

(Philadelphia Inquirer, submitted by J. Rosewald Jr.) A photographic description of a series of earthquakes in San Jose, Costa Rica, was given to a Philadelphia radio ham recently. William Weisbord, 57, was talking to a fellow ham in Costa Rica when the quake hit and forced the station to go off the air.

Weisbord learned from another station in Costa Rica that no serious injuries had occurred although considerable property damage resulted. The same night other stations were monitored and they also reported earthquakes in their areas.

New Books

You know, you could do a lot worse than keep up with the Rider Electronic Technology Series of publications. The latest in this series are two books by Dr. Alexander Schure, one on **Transformers** (#166-37 @ $2.00) and one on **Filters and Attenuators** (#166-36 @ $2.25). The books give you a thorough treatment of the theoretical and practical aspects of these circuit elements. These books cover each element of electronics with care that could never be used in a single book.

Locate and Eliminate Interference

How To Locate and Eliminate Radio & TV Interference, Rider #158, $2.90, is the second edition of this book—covers the subject quite well. It explains what makes noises, what you use to track them down, how you go about finding some of the more difficult ones, and what you do about them after you've located the misery.

Citizens Band Radio

Citizens Band Radio, Rider #273, $3.90, is more handbook than anything. It gives all the rules, covers just about every piece of available equipment and its application, the antennas, power supplies, kits, servicing, etc. Hams, whether they themselves like CB or not, are expected to be experts on the subject. This book will make you an expert.

Transistor Substitution Guidebook

The new Rider (#276, $1.50) **International Transistor Substitution Guidebook** for direct transistor substitutions has been badly needed. It lists over 4500 direct substitutions of American, Japanese, British, Dutch, French, Italian and German transistors.

Basic Mathematics

A lot of fellows, as a result of the terrible teaching methods being used in many schools, have gotten the idea that math is not for them. Since math is so fundamental in our hobby it stands to reason that this trauma should be repaired if possible. This book (Rider #268-1, $3.90) certainly should get almost anyone over the idea that math is hard to understand.

Letters

Dear Wayne:

Just flipped the back cover of August 73 closed with my usual smug grin of satisfaction, but this time you have hit an article that really takes my fancy. I refer to the article about the KW transistor mobile transmitter on page 72. You have finally hit on what I've been looking for for years and I am starting to build it immediately; that is just as soon as I can find the parts in the catalogue. Can't seem to find some of them. Had the same trouble finding the parts list in the article. You really have to look this one over close as it tends to elude you. Hope I don't have too much trouble identifying the parts when they come.

For years I've wanted to put a mobile rig in the family bus, but the XYL always complained that it got in the way of her knee's. Now I can have a gallon right under her nose and she won't even know it's there. She may think I've finally blown my gasket when I start talking to someone but that's alright because she thinks I'm nut's anyway, so that won't be anything new. My one big hope is that it will be as inconspicuous in the car as it is in the magazine. I wonder if you have any idea's for an invisible whip to go along with the rig? The regular whip may give me away. I thought I might be able to use a throat mike instead of a hand mike, then I could crank up the gain and just mumble, my wife says I mumble all the time any way so she will be used to this and may never catch on. I can hardly wait.

So listen close on 20 meters in the near future Wayne and when you hear a large clear spot of beautiful dead silence you will know I'm on the air. By the way I have heard a lot of guy's around town grumbling: seems the printer's left this article out of their magazine. Well I'll loan them mine when I finish the rig. Wonder what you have for next month. . . .

Earl Spencer K4FQU

Dear Wayne:

I just finished reading Frank Merritt, Jr's fine article "The Drake Receiver" in your August issue. There are a few points however, which I feel require some clarification. First, all 2-Bs have a fast AVC decay time of .025 seconds rather than the .05 second figure mentioned in the article. While it was true that the 2-A has a .05 second decay time, this figure was reduced in the 2-B to permit greater ease in operating break-in CW. The first audio amplifier stage consists of the triode section of an 8BN8 tube. The two diode sections in this tube are used as bias rectifier and AM noise clipper respectively. This arrangement is common to all 2-Bs as well as many 2-As.

There have been no significant modifications in the 2-B since production began, so a modification service on it is not available nor necessary. Because of the expense involved and the chassis alterations which would be required, we do not feel that it would be practical to modify earlier 2-A receivers to include noise limiter circuits and are not offering such a service.

It is also worth noting that the 2-B combines the advantages of a "ham band only" receiver with the capabilities of extended coverage. It is equipped with five accessory bandwidth positions which permit the addition of five 600 KC tuning ranges between 3.5 and 30 mc by merely adding the appropriate crystals to the respective socket. This feature is particularly useful for "MARS" coverage and would prevent it from becoming obsolete in case changes were made in amateur band frequency allocations.

All of us here at the R. L. Drake Company were well pleased with the article and we would like very much to congratulate Mr. Merritt on a job well done.

James F. Waits, Engr. Dept
R. L. Drake Company

ar Wayne:

Oops! is doubly appropriate for yer July issue. Don't z know a dipole from a vertical ground plane either? Hi. (Page 8.)

Would you please inform our readers that they should oss out "18 inch elements and two of the" in the ghth sentence below the picture of the "Tinker Toy ree Element Beam" on page 10. Otherwise they would d up withsix quarter wave segments in the driven ement. Thought I marked that "delete" on the 'oofs.

My only other complaint, Wayne, is that you really it your readers on the spot in asking them to vote for e best articles each month. There are so many good ies in this month that a fellow could develop some rt of complex in attempting to make such a weighty ecision. Keep up the good work.

Bill K8LFI

(W2NSD from page 4)

July Votes

July was the nip and tuckiest month yet, otewise. The Two Meter Nuvistor Line Amplier nudged out Tinker-Toy for Two by only welve votes out of over 1500 for each! We'll ontinue to run Nuvistor articles in spite of RCA's complete indifference to 73 as an advertising medium. We have several more good Nuvistor articles being prepared for publication, including a fine 220 mc converter.

Our big Pandaptor was in third place by nly seventeen more votes. Nine votes behind vas our Big Technical Article on power supplies, and tied with it was W7CSD's article on AM systems. That was quite an issue. Be sure to send in your vote for articles you like best in this issue as this helps me to decide what to publish in the future and pays off the winning authors with an extra 50% pay.

August should be a light month for votes, but they are coming in hot and heavy. The Nuvistor converter seems to have a strong lead so far, but a sudden surge of votes for the Impedance Bridge or the Deviation Meter could change the order. You may have noticed that there was a place to vote for the most interesting ad on the card too. I had in mind giving maybe a 50% rebate for the ad which wins this vote each month. The purpose of this would be to encourage companies to put a little more effort into their advertising and eventually make the magazine more interesting to read. The Drake ad is leading so far, with Clegg Laboratories not far behind.

Renewals

With several thousand subscription renewals all coming due this month I was a bit worried about how hard a time we would have in getting the fellows to re-subscribe. I needn't have worried. With still one more issue to go there are now less than 500 who have not renewed! If your stencil ends in 91-01-N1-D1 then your subscription is running out. Send money.

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Kit 4 "Suncells" Asstd.
Kit 5 Sub-Min Tubes

Kit 75 Mica Condensers
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Kit 200ft Hook Up Wire
4 Rolls, 50ft/ea. Asstd. Color
Kit 100 Ceramic Condensers
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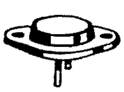

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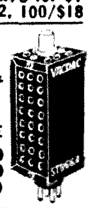

TYPE	VRMS/PIV	AMPS	PRICE
ST866	5000/10400	0.3	$20.00
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Send 25¢ for Catalog

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0Z4	.79	*We Trade!*		RK60	1.17
1A7	.90	6CB6	.89	HY69	2.20
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We Swap Tubes! What Do/U Have?

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1T5	.95	6CU6	1.29	4-400A	41.75
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2C51	2.00	6F8	1.39	350A	2.45
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5Y3	.60	12SF5	.69	957	3/$1
5Z3	.89	12SG7	.89	958A	2/$1

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6AB4	.59	12SL7	.79	1620	2.00
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Top $$$ Paid for 304TL, 813, 811A, 812A Tubes

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6BA6	.59	25L6	.72	5670	.90
6BE6	.59	25T	4.00	5686	1.75
6BG6	1.49	25Z5	.72	5687	1.15
6BH6	.79	25Z6	.75	5691	4.70
6BJ6	.72	26A7	3.69	5725	1.95

Top $$$ Paid for XMTTR Tubes!

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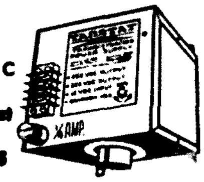

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DC AMP	18VAC 14VDC	36VAC 28VDC	72VAC 54VDC	130VAC 100VDC
½	$1.00	$1.90	$3.85	$5.00
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One Year Gtd!

GTD† HIPOWER-15 AMP TRANSISTORS Factory-Tested
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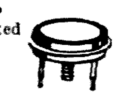

2N277 or 2N441 @ $2,
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Use as Amplifier—Oscillator—HIFI
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OCTAL SILICON DIODE REPLACEMENT 1120Rms/1600Piv
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Enclose 25¢

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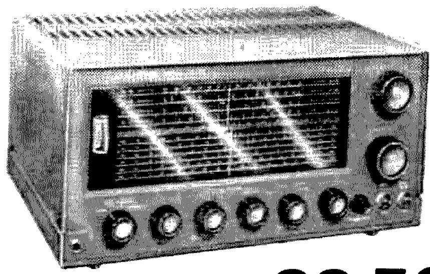
THE LAFAYETTE HE-30

Professional Quality Communications Receiver



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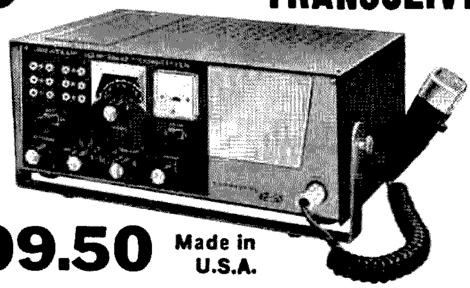
Sensitivity is 1.0 microvolt for 10 db, Signal to Noise ratio. Selectivity is ±0.8 KCS at —6db with Q-MULTIPLIER. TUBES: 6BA6—RF Amp, 6BE6 Mixer, 6BE6 OSC., 6AV6 Q-Multiplier—BFO, 2-6BA6 IF Amp., 6AV6 Det-AF Amp. ANL, 6AQ5-Audio output, 5Y3 Rectifier.

New! LAFAYETTE HE-50 10 METER AMATEUR TRANSCEIVER



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A significant step forward in 10-meter communications. The Lafayette HE-50 transceiver sets new standards of flexibility and performance in the 10-meter band.

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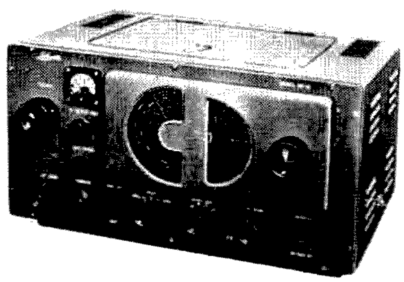
TOP VALUE COMMUNICATIONS RECEIVER

KT-200WX in Kit Form **64.50**

HE-10 WIRED AND TESTED **79.95**



• SUPERHET CIRCUIT UTILIZING 8 TUBES AND RECTIFIER TUBE • BUILT-IN "S" METER WITH ADJUSTMENT CONTROL • FULL COVERAGE 80-10 METERS • COVERS 455KC TO 31 MC • VARIABLE BFO AND RF GAIN CONTROLS • SWITCHABLE AVC AND AUTOMATIC NOISE LIMITER

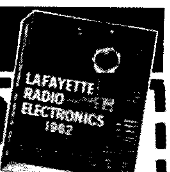
The Communications Receiver that meets every amateur need—available in easy-to-assemble kit form. Signal to noise ratio is 10 db at 3.5 MC with 1.25 microvolt signal. Selectivity is —60 db at 10 kc, image reflection is —40 db at 3 MC. Tubes: 3—6BD6, 2—6BE6, 2—6AV6, 1—6AR5, 1—5Y3.

HE-28 RF WATTMETER AND SWR BRIDGE

36.95

Measures SWR & Relative Power up to 1 KW. 150 watts full scale—built in dummy load—Wattmeter ±5% to 50 mcs. SWR ±5% for in line use.

SEND FOR LAFAYETTE'S NEW 1962 CATALOG



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☐ Send FREE 1962 Catalog 620 featuring the full line of Lafayette Ham Equipment

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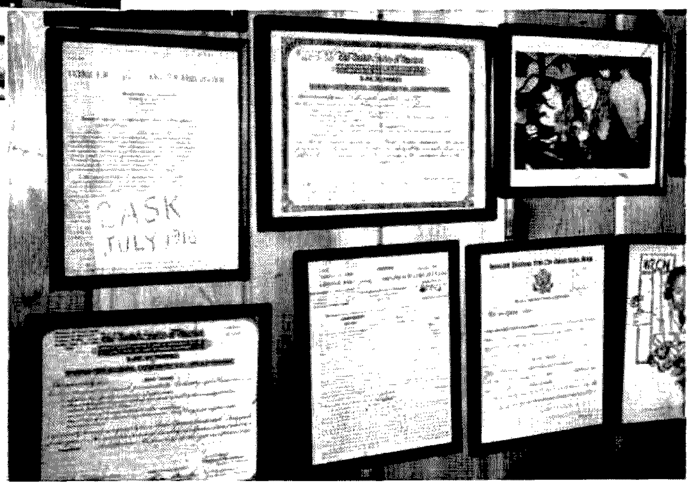
25 YEARS with PR!

■ Adolph Schwartz, W2CN, is celebrating his 25th year as sales representative for PR Crystals. But W2CN was a ham operator long before that. His original ham license was dated April 12, 1916 . . . Commercial First Class License dated 1917. Before and after World War I, Adolph had call letters 2AFT and 2ASK. He has always been an active amateur, and his present license is Amateur Extra First Grade.

■ Here is W2CN at his rig. Rx-Collins 75A4. Tx-Johnson KW Final. Driver Johnson Pacemaker. Antennas: 40M, inverted vee dipole. 20, 15, 10 M, 3 separate 3-elem. beams. W2CN is active on SSB, AM, and CW, on 40, 20, 15 and 10 meters. He likes to chase DX and has over two hundred confirmations. Give him a call sometime.



■ Top Row: 1916 Ham license; renewal 1917 Commercial License; Bill Eitel and W2CN. Lower Row: First Class Commercial License, 1921; 1919 Ham License 2AFT; U.S. Army Discharge; W2CN tied to ball and chain.

■ PR Crystals have been the standard of quality since 1934. It was their outstanding performance and dependability that first interested Adolph Schwartz. In March 1936 he started using PRs in his rig at W2CN. He was so impressed by PR Crystals that he immediately asked to be their sales representative in the New York territory. Says W2CN: "It is a pleasure to sell PR Crystals because they are quality products that operate without trouble to their owners."

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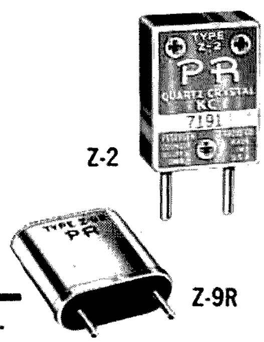
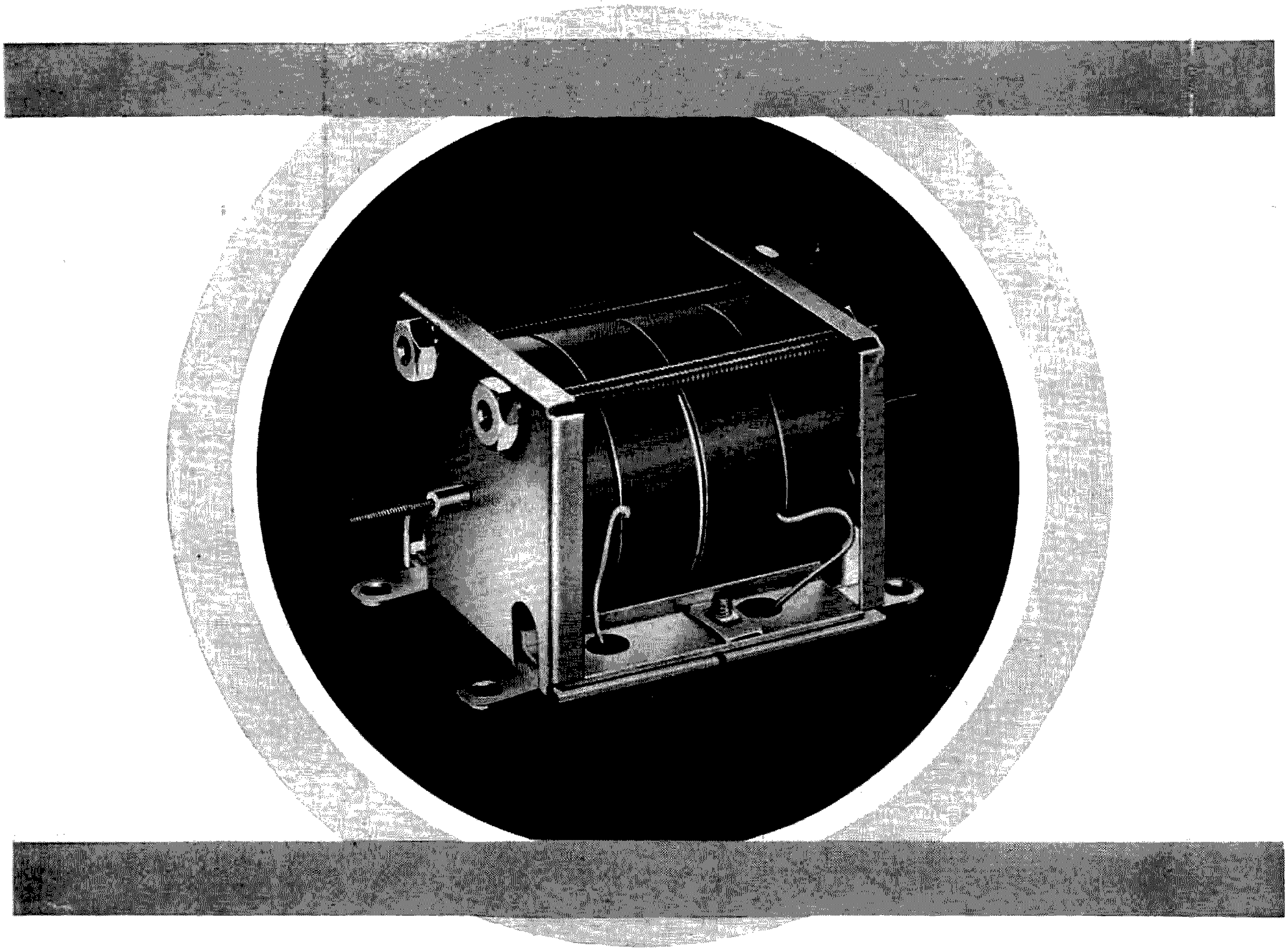


Z-2

Z-9R



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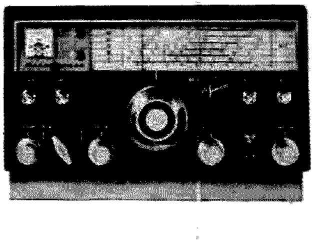

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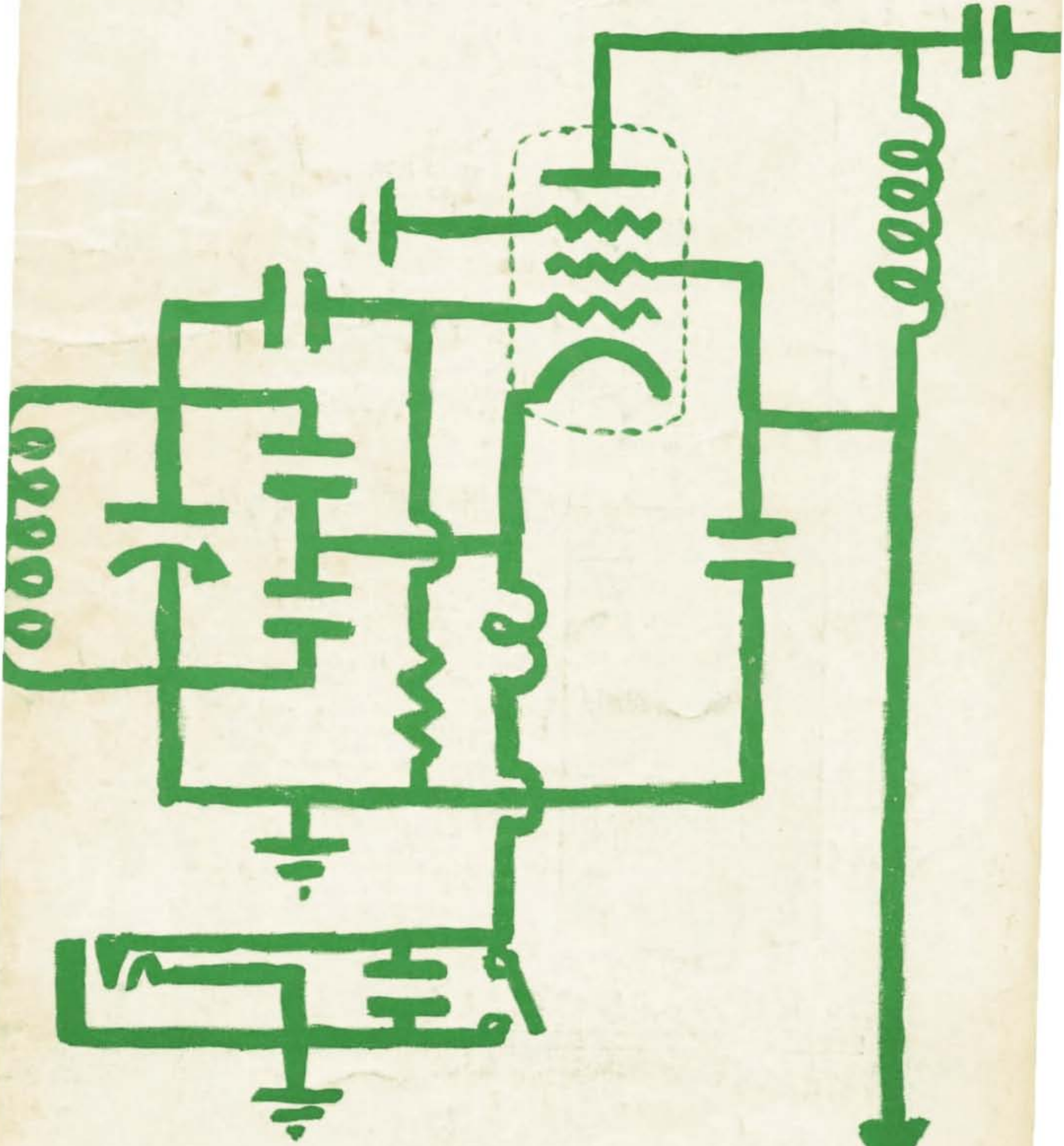

73 Magazine

1379 East 15th Street—Brooklyn 30, New York

Wayne Green W2NSD—Editor, etcetera October 1961, Volume 1, Number 13

Six Meter Linear Amplifier .... Bert Green W2LPC 6
90 watts AM, 360 watts PEP SSB, 2½ watts drive to pair 7378 s.

Simple High Stability, VFO .... Fred Haines W2RWJ 14
5763 osc., 5763 buffer. Colpitts circuit.

73 Tests the Central 200V .... Staff 18
It works.

CQ de 73 .... Roy Pafenberg W4WKM 22
Converting the ARA-26 surplus keyer for ham work. Inexpensive, and lots of fun.

Like New Mixer Circuit .... Staff 32
New way to improve sensitivity and stability of your receiver.

Two Meters the Easy Way .... Roy Pafenberg W2WKM 36
The MRT-90 packset, available surplus, makes a terrific two meter transceiver.

Useful Accessory for the Shack .... Rex Morris W2WXH/6 38
You can't get along without this wavemeter/field strength meter/monitor.

Inexpensive Vertical .... Ken Johnson W6NKE 40
Easy to put up, tunes 80-40-15 meters, and works out fine.

Dual Diversity Beam .... George Messenger K6CT 42
This, we predict, will be a very popular DX'ing antenna.

VFO Circuits .... Staff 46
Good and bad features of all known circuits. Our big technical article.

Obtaining that DX License .... Gus Browning W4BPD 58
Gus divulges his secret tactics which will soon give him a reverse DXCC.

Sequential Electronic Switch .... Pat Miller KV4CI 62
Key VFO and final screens in sequence for clickless spark-free keying.

Propagation Charts .... Dave Brown K2IGY 64
What time to where, on what band . . . probably. For world and U. S. short path.

Send-Receive Ground Switch .... Howard Pyle YB of W7OE 66
Antenna switch for simple ham stations. Also keeps lightning out

Maximum Utilization from Variacs .... Thomas Snyder W4CAG 72
Very useful devices. They're available surplus if you hunt around. Even new they're worth it.

Construction Do's and Don't's .... Jim Kyle K5JKX/6 76
Rules of the game. Read please.

Emcar 6 .... Emil Carp W3JXT 82
Why you should get a Porsche to go with your mobile rig.

Little Thief .... Edward Noll W3FQJ 84
Li'l one tube CW rig powered from your receiver.

Associate Editors W3UZN, W4API, K5JKX/6, VE3DQX
Western Representative: Jim Morrissett WA6EXU, Box 847,
Reseda, California. Ph: DI 5-2077

Cover: Radio Circuit, painted by hand by Wayne Green, age 39.

de W2NSD 2
Letters 12
Simple Antenna Mast 20
Junk Box 31
Silicon Rectifiers 44
Meter Shunt Winding 73
X-sistor Symbols 74
Surplus Speakers 75
Instant Band Change 80
Refinishing 80
New Products 83
Lifers 81
Coil Forms 85
1625's 85

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... de W2NSD

(never say die)

Everything Is a Big Deal

One of the most frequent questions at conventions is, "How many people do you have working on 73?" They are amazed when I tell them that just two of us are doing it all. They would be even more amazed if they had an idea of the work that is involved.

As an example, and rather typical, let's see what we had to go through to get the cover for September. Maybe you remember that mosaic quad design. Step number one is thinking up the design. This occurred to me while I was looking through a catalog from an artist supply house and saw that tiles weren't too expensive. Hmmm, how about doing something in tile for the cover? I sat down with a pad of quad ruled paper and worked out the design, trying to make it something that was typically ham and still make enough of a pattern so it would be artistic. Tiles are rather limiting as a medium.

Once the design was set I counted up the tiles needed and drove over to Manhattan to get them. Virginia did the actual work of pasting them on a large sheet of cardboard with special tile glue. This took hours and hours. When she was done she mixed up groat (a white powder) and wiped it into the cracks between the tiles. Then the finished work had to be taken over to New York for a photograph. That's two trips so far, at two hours each trip. Then one more trip to bring back the tiles and the finished photo. A couple of sections of the photo didn't come out very well so I sat down with a scissors and cut up the two prints and pasted them together to make one good print.

The print was then mailed to the engraver to have the front cover engraving made. When proofs of this came back a few days later I was horrified to find that many of the white lines had dropped out entirely. It looked awful! I drove over to Manhattan again and gave it to Dave Fish, our production man, to heavy up the weaker lines a bit. He had a negative photostat made of it and inked in the lines with a hand pen in black and then sent it back to the engraver again for another cut. This time it came out fine and the cut was finished just in time to rush it by special messenger to the printer's local office in Manhattan so he could send it by special messenger up to the printing plant in Connecticut. Whew!

As I was breathing a sigh of relief I got a call from the printer. The plate had been made two inches too large and wouldn't fit in the presses. After measuring it carefully he found that he could trim off the nice borders I had on it and just get in all the words and the design. With a quivering voice I agreed that there was nothing else he could do.

So that's how we made our September cover. It took at least ten hours of work by Virginia and another ten by me to get it done. This, unfortunately, is not particularly a special case. I've had to do the design on all but our March cover myself. Oh, how I wish someone else would come up with some good ideas. The rules are simple, the cover should be relatively simple, artistic, and as different as possible from anything you might see on any other ham magazine. I like to use only one or two colors due to the costs involved.

Maybe you think the cover was unusually time consuming? Well, let me tell you about what happens to every article that we publish. First of all the article arrives in the mail one day (sometimes I get a letter asking if I am interested in a particular article and have to write back that I am). This then is dated in and goes into a large carton of articles to be read. I read these when I get a chance and it sometimes takes weeks before I have time. Flying trips to conventions are great for this, I get lots done on them.

Once read I either return them immediately with an explanation or else set to work to figure out how many pages the article will run in the magazine. I count up the number of lines of copy, measure the length of each line, and then use a chart I have developed to estimate the number of inches of column space it will take (36 inches of typewriter copy equals one column-inch). Then I add a couple of inches for the title space, size up the diagrams and figure how large they will run, measure the photos and, using another chart, add in this space. This takes a lot of time, but I haven't figured out how to do it any faster.

When the space has been calculated I note on the article folder how much room to allow for it and then write out a check for the number of pages, times $20 per page. Next I have to go through the article again and correct it for spelling, grammatical errors and deviations from our standard style. At the same time I mark it up for the printer to set in

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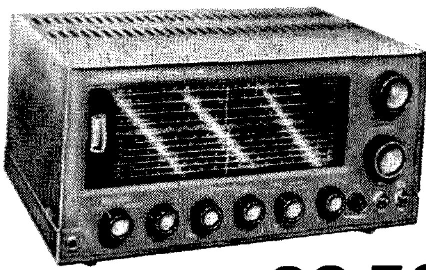

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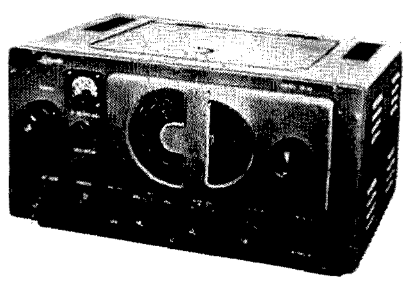

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type, specifying the exact size and style of type and the length of each line. Frequently there is considerable rewriting necessary or massive deletions to take out repetitions.

The photos have to be marked for the engraver so he will know what kind of cut to make, what screen to use, and what size to make it. These are then packed in a special envelope and mailed to the engraver. Diagrams are marked as to the finished size desired and all parts values are written in on the diagram. I much prefer to have as much information on the diagram as possible and keep away from long parts lists. The diagrams are then mailed to our drafting department. The text is mailed to our printer.

About four days later the engravings are delivered to our printer and the proofs come by mail to our office. These are filed in the folder assigned to the article. A week or ten days after that in comes the galley proofs of the text. We send two copies of these proofs to the author with a note asking for him to return one, the remaining copies are filed in the folder. Two weeks after this I get word that the drafting has been completed and is ready to be checked. I drive over to Manhattan and carefully check each diagram, marking all corrections. About a week later I receive engraving proofs of these diagrams in the mail. Now, if the author will get those galley proofs back, we can set the article up in page form.

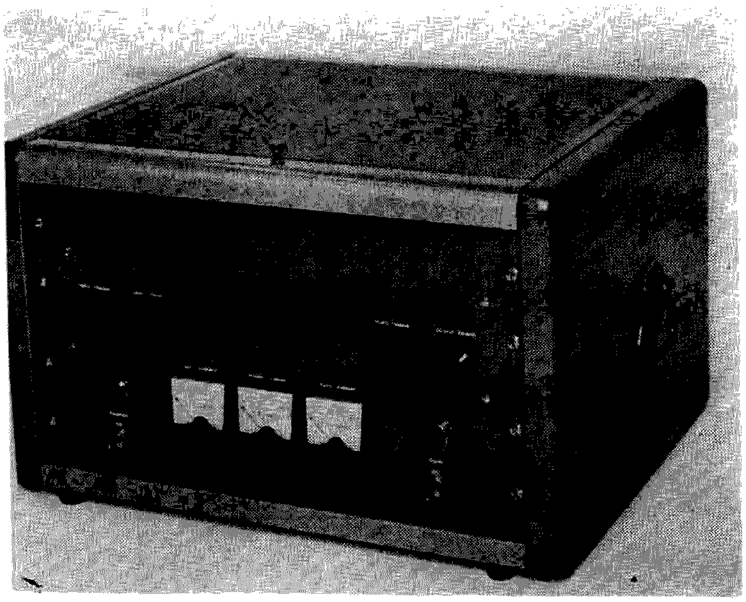
A few days later in come the proofs. I note with dismay that the author has thought of a whole bunch of things he wishes he'd said originally and has them written in the margins. I cross all that out (it cost a fortune to reset type) and leave only the actual corrections of typographical errors. These are then filed in the article folder.

Each month I sort out from the complete articles those that we want to use and Virginia starts pasting them up. This means cutting out all the proofs of text, diagrams and photos and pasting them into the place that we want the printer to put them for the finished page. It is very tricky to lay out a page so it looks well.

While the pages are being pasted up Virginia has to make sure that she has all of the photographs and diagrams in the right place. She often finds that one is missing and has to hunt it down. It may turn up still on the drafting table, on a shelf at the engravers, or mislaid somewhere at the print shop. She has to make a note on the proofs of all corrections found by her and the author so they can be corrected while the page is being made up. The pasted-up pages are mailed to the printer. A week or so later we get a proof of the completed pages. A copy of this is mailed to the author and the remaining copies filed.

Once the advertising space is fairly definite we can assign page numbers to articles. This

(Turn to page 69)



An AM Linear for Six

Bert Green W2LPC
and Michael Leis
c/o Amperex Electronic Corporation
Hicksville, New York

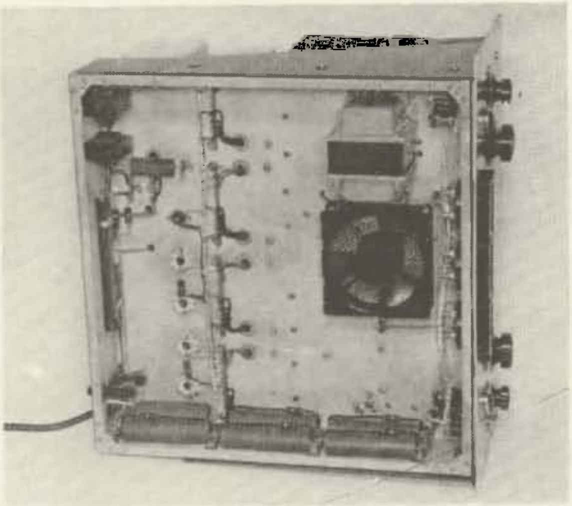
HOW would you like to raise the power output of your present 6 meter AM transmitter from 2.5 watts to 90 watts without investing money in a system that will be obsolete in a few years? This would automatically rule out the construction of the conventional Class C Amplifier and accompanying modulator. There is one method of increasing the output of your present low powered AM transmitter and still be able to use this new equipment for Single Sideband in the future years. The answer is an AM Linear Amplifier.

For those not familiar with Linear Amplifiers the following information may be enlightening.

1. The construction and operation of an AM or SSB Linear Amplifier is the same.
2. The efficiency of a Linear Amplifier when used with a SSB signal is about 40 to 50% while with an AM signal the efficiency drops to about 25 to 30%.
3. The efficiency of a Linear Amplifier varies with the amplitude of the input signal. When the input signal is zero there is no output and thus the efficiency is zero. As the input signal is increased the efficiency of the amplifier increases reaching a maximum of about 70%.
4. The peak to average ratio of a 2 tone SSB signal is 2:1 while the peak to average ratio of a 100% sine wave modulated AM signal is 4:1. From this it is obvious that since the average power level of the SSB test signal is twice that of the AM signal therefore the average efficiency should be much higher for the SSB signal.
5. The efficiency of a Linear Amplifier for a 2 tone SSB signal will generally run between 40 to 50%. For a 100% sine wave modulator AM signal the efficiency is about 25 to 30%.
6. A Linear Amplifier with 200 watts of plate dissipation available will be able to produce approximately 180 watts of SSB output or 90 watts of AM output.
7. It should be kept in mind that the 180 watts SSB power represents 360 watts peak power and that the 90 watts of AM also represents 360 watts of peak power. This means that in either case the amplifier will linearily amplify a signal up to 360 watts peak power.

From the above facts the conclusion is reached that if a Linear Amplifier is constructed for our 6 meter AM exciter, this amplifier will still be useful when SSB arrives on the scene in years to come. As most 6 meter exciters produce only a few watts output an amplifier that would increase the output to somewhere near 100 watts would really be worth while.

For our amplifier we decided to use a pair of Amperex 7378's. This tube is a new radiation cooled glass tetrode that was designed for low voltage high current operation as a Class AB, linear amplifier. This tube is so new that ICAS ratings and ratings above 30 megacycles



are not as yet published. The CCS ratings show the anode dissipation at 100 watts up to 30 megacycles without any air cooling required. The tube carries a maximum CCS voltage rating of 825 volts and a maximum CCS plate current rating of 400 milliamps.

For 50 megacycles we decided to run the tube under CCS ratings with a small blower supplying air cooling to make up for the increased heating at the higher operating frequency.

Amplifier Circuit

The rf Amplifier Section consists of a standard push-pull circuit using two 7378's (Figure 1).

A 50 ohm input line is coupled to the grid tank via L_1. The input power is adjusted by varying the coupling between L_1 and L_2 and tuning out the reactance of L_1 by means of the series capacitor C_1.

The grid tank capacitor rotor is grounded (C_4). The bias voltage is fed through a 47 ohm decoupling resistor (R_1) to the center tap of the grid coil. Each grid is fed through a parasitic suppressor consisting of a coil in parallel with a resistor (L_1R_2) (L_3R_3) to give a resultant impedance of 18 ohms at 50 megacycles and 23 ohms at 120 megacycles. This was used to suppress a parasite at 120 megacycles, the parasitic input circuit being formed by the cathode lead inductance and the cathode capacitance to the grid and filament.

The cathode is grounded by means of a heavy copper plate, which extents the full width of the tube socket. This low inductance cathode lead keeps the parasitic frequency as far above the operating frequency as possible.

Neutralization is accomplished by series tuning the screen by means of capacitors (C_9, C_{10}, C_{11}, C_{12}) tied back to the cathodes. It is advisable to return the capacitors back to the cathode itself rather than the ground side of the cathode lead so that any rf voltage developed across the external cathode lead does not affect the neutralization. The neutralizing capacitors were paralleled since a physically small capacitor with sufficient capacity was not readily available.

The screen grids are decoupled from the power supply by means of resistors (R_4, R_5). These resistors are shunted with rf chokes (L_5, L_6) to prevent the resistors from impair-

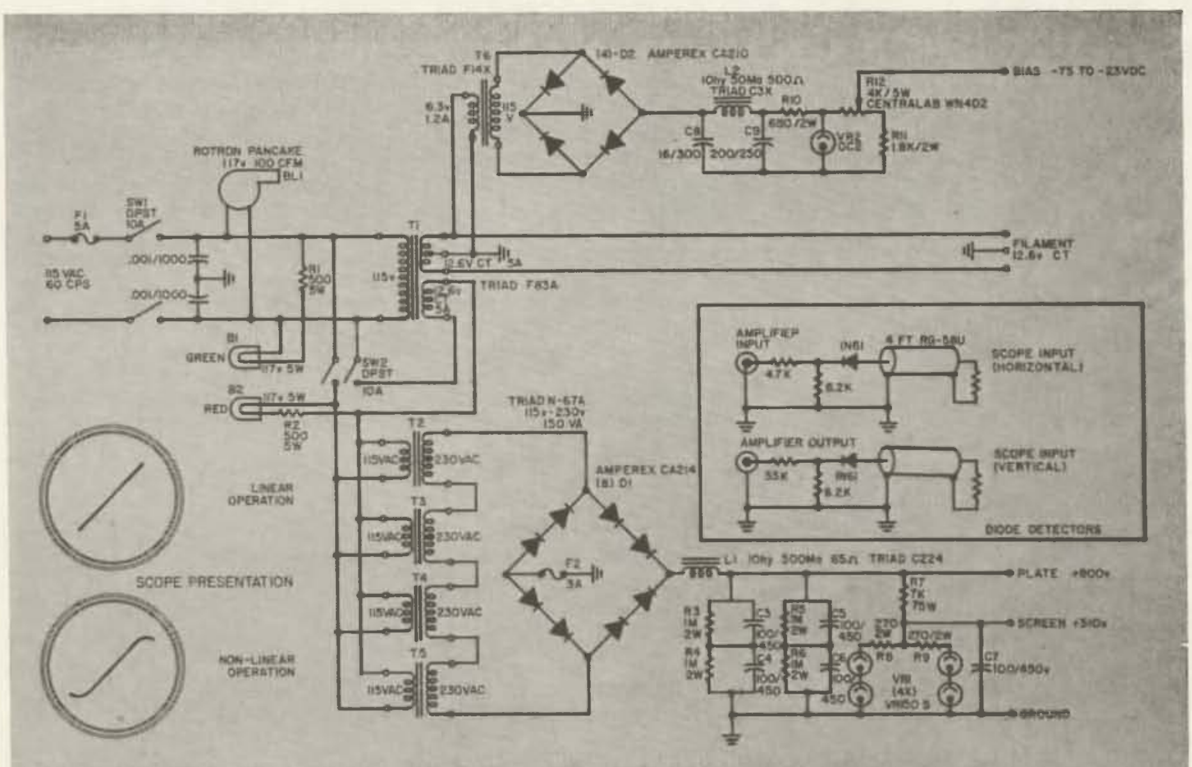


Fig. 2

ing the dc regulation of the screen supply voltage. For linearity the dc screen voltage must be held very constant.

The rotor of the plate tank capacitor (C17) is left floating so as to permit the plate circuit to seek its own balanced ground. For the same reason the tank coil (L_7) is decoupled from the plate supply by means of resistor (R_6). A shunting rf choke (L_9) keeps the dc voltage drop across (R_6) to a minimum thus maintaining constant plate voltage to the tube.

Generally, parallel mode oscillation of a push pull oscillator is prevented by floating the ground of the tank circuit and inserting some impedance in the ground lead as described above. The explanation being that if the tubes tend to oscillate in a parallel mode then the resistor (R_6) and rf choke (L_9) are in series with the tank circuit reducing the Q of the tank circuit to a point which prevents oscillation. For push pull operation no rf currents flow through the resistor (R_6) and rf choke (L_9) thus the Q of the tank is maintained.

Initially, a parasitic oscillation of 180 megacycles was present. This parasite was traced to the series circuit consisting of the plate capacity, plate to tank circuit leads, and the capacity of the tank capacitor (C_{17}). This oscillation occurred only when the tank capacitor (C_{17}) was near its maximum capacity range. However, this portion of the capacity range was not necessary for tuning the 50 to 54 megacycle range. Therefore, 4 rotor and 3 stator plates were removed from each side of the tank capacitor (C_{17}) to remedy the above problem.

The 50 ohm output line is coupled to the plate tank circuit by means of the coil (L_8) which is movable to permit variable loading. The reactance of the coil (L_8) is tuned out by means of the series capacitor (C_{18}).

Power Supply

The power supply schematic is shown in Fig. 1 and the requirements are as follows:

Plate........800 Volts dc @ 400 ma
Screen........310 Volts dc @ 26 ma
Bias...... —25-75 Volts dc @ O ma
Filaments.....6.3 Volts ac @ 8 amps

A plate transformer to fit the above requirements was not commercially available. Therefore four line isolation transformers (T_2T_3 T_4T_5) of the 230v/115v type were used with the 115v windings in parallel as the primary and the 230 volt windings in series as the secondary.

When considering a typical 230v/115v isolation transformer it should be noted that the winding ratio of the transformer is not 2:1 as the published voltage ratio would indicate but rather 2:1.05 to compensate for the drop in the secondary voltage due to loading. If we now use this transformer backwards (115v/230v) then we have a ratio of about 1:1.9. This means that instead of getting 115v to

920v from our transformers we were only able to get approximately 870 volts. In order to attain sufficient secondary voltage it was necessary to use a spare 12.6 volt winding on the filament transformer (T_1) as a line boost transformer in the primary of our plate transformer.

The bias voltage is secured from transformer (T_6) which is a filament transformer hooked up backwards and securing its 6.3 volt primary voltage from one side of the 7378 filament transformer (T_1). Since the primary current requirement of the bias transformer is very low it does not upset the balance of the 7378 filament transformer.

The filament of each 7378 is connected to one half of the 12.6v winding on the filament transformer (T_1) with the transformer center tap leg being common to both filaments. This provides 6.3 volts to each tube filament.

Construction

The power supply is mounted towards the rear of the chassis and the amplifier is in the shielded compartment towards the front. The shielded compartment is constructed of perforated aluminum. The blower is mounted under the chassis just below the 7378's. The plate rf choke (L_9) is mounted in a shield can (open at the top) to aid in keeping the cold end of the choke out of the rf field. The shield can is a 35 mm film container.

Standard components are used for the physical construction. The chassis is aluminum 17"x17"x4". The cabinet is a Premier Prem-O-Rak 18" deep x 12⅞" high. The front panel is aluminum 19"x10½".

Neutralization

The amplifier is neutralized by means of screen grid neutralization. Limited drive is applied to the input of the amplifier so as not to exceed 1 ma on the grid current meter with no voltage on the screen or plates of the tube. A grid dip oscillator, set to diode position so as to act as a sensitive wave meter is held near the plate tank coil. With all the tuned circuits in the amplifier adjusted for maximum reading on the wave meter, the screen neutralizing cendensers (C_9, C_{10}, C_{11}, C_{12}) are adjusted until a minimum output is indicated on the wave meter.

Amplifier Tuning

For maximum power output in conjunction with the greatest degree of linearity the tuning procedure requires in addition to the front panel meters some means of monitoring the degree of distortion. A relatively simple method of distortion monitoring may be accomplished in the following manner. A diode peak detector circuit is connected to the input of the amplifier while a second one is connected to the output of the amplifier. One of the above peak detectors is connected to the horizontal input of a scope while the other detector is connected to the vertical input of the scope. When the amplifier is linear, that is the output signal is exactly the same as the input signal, the trace on the scope will be a straight line. Any distortion in the amplifier will cause the straight line display on the scope to curve at the ends.

Fig. 2 shows the schematic of the diode detector circuits for monitoring the input and output circuits. Fig. 2 also show a typical scope presentation for linear and nonlinear operation of the amplifier.

To adjust the amplifier, using a 100% sine wave modulated signal source, the input capacitor (C_1) and the grid tank capacitor (C_4) should be tuned for maximum plate and screen current while the drive power from the exciter is adjusted to a level just at the point of grid current. The plate tank capacitor (C_{17}) should be adjusted for resonance (maximum power output) and the output link capacitor (C_{18}) should be adjusted for maximum power output. The coupling between the plate tank circuit and the output link (L_8) should be adjusted for greatest power output while still maintaining good linearity. This may be done by watching the scope as described previously. The final object being to achieve the longest straight line scope presentation. During the

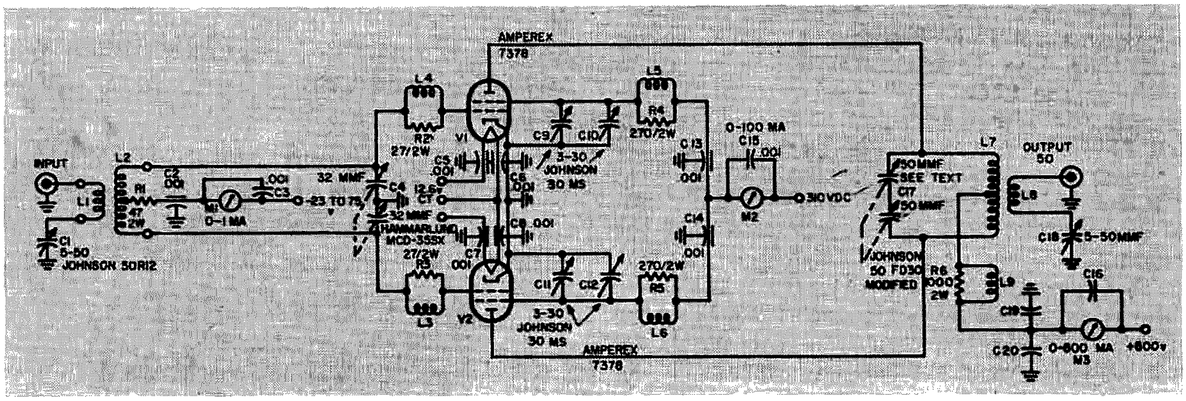


Fig. 1

"Terrific!...Unbelievable... Best rig – ever"!

Here are a few unsolicited comments from owners of Clegg VHF equipment

Clegg Zeus VHF Transmitter FOR 6 AND 2 METERS

A highly efficient, 185 watt AM, high power VHF transmitter for full coverage of the amateur 6 and 2 meter bands and associated Mars frequencies.
Automatic modulation control with up to 18 db of speech clipping provides magnificent audio with "talk power" greater than many kilowatt rigs.
This beautiful unit with its ultra-stable VFO is the ultimate in VHF equipment for amateur and Mars operation.

99'er Transceiver

FOR 6 METERS

This completely new transmitter-receiver is ideal for both fixed station and mobile operation. Small in size, low in cost, and tops in performance, the 99'er offers operating features unequalled in far more costly equipments. The double conversion superhet receiver provides extreme selectivity, sensitivity and freedom from images and cross modulation. The transmitter section employs an ultra-stable crystal oscillator which may also be controlled by external VFO. An efficient, fully modulated 8 watt final works into a flexible Pi network tank circuit. A large S meter also serves for transmitter tune-up procedure.

From Ohio:

". . . I am a quality control supervisor with a leading electrical manufacturer and this Zeus transmitter is to me the finest piece of workmanship that I have ever purchased or inspected . . ."

Richard E. Hayes, K8UXU

From New Hampshire:

". . . We feel that our new Zeus is the best thing that ever happened to us since we have been in ham radio (5 years) . . ."

Hazen & Beatrice Bean, K1JFQ

From Florida:

". . . We are well satisfied with the results of this unit as we have worked forty DX contacts in little more than three hours on May 23, 1961, including six new states which we were unable to work in the past two years with a 120 watt, 6 & 2 transmitter of a different mfg. . . ."

Jack Edlow, K4YIW

From California:

". . . Never before have I been more pleased with a piece of gear than I am with my Zeus. In two days I have worked 24 states with several contacts in each, (phone) on six meters. And the signal reports — yow! For the most part unbelievable . . ."

Jeanne & John Walker, WA6GEE

From Pennsylvania:

"Words cannot express the pleasure and performance of ZEUS. I have worked 5 states 5-9, plus I have given you $1,000,000 advertisement . . ."

Dr. A. Schlecter, K30EC

From Puerto Rico:

". . . I want to inform you of the excellent results obtained with the Zeus Transmitter I bought one month ago. Taking advantage of the band opening, I have been able to work up to the present thirty-eight states, including California . . ."

Pedro Fullana, KP4AAN

From New Jersey:

". . . I would like to tell you I am more than delighted with the operation of the Zeus. Have had nothing but good reports from other Ham's . . ."

Donald E. Gillmore, WA2QCQ

From Georgia:

". . . This set is terrific. I've had terrific results with it. It's the best rig — ever."

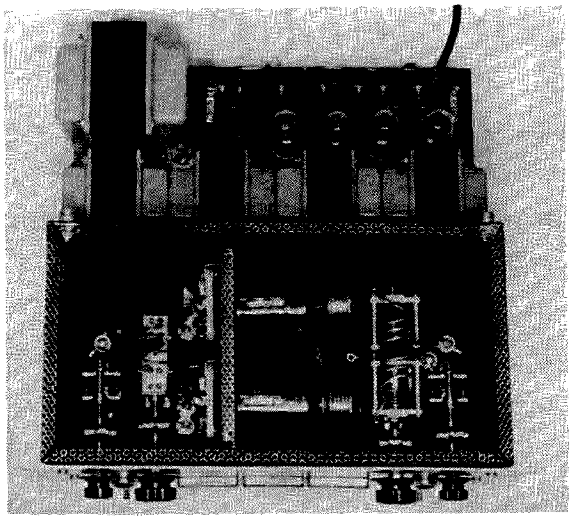
George E. Missback, K4QOE

K8CHE in Ohio tells about 99'er

". . . with the 99'er haywired in from a four element beam, through 100 feet of coax, through a matching network, through a length of 72 ohm twinlead, and then through a length of 300 ohm twinlead to reach the 99'er, we could read the Michigan stations Q5! and back through the above haywire we were able to put 4.4 watts into the antenna as measured by a RF ammeter! . . ."

Ken Phillips, K8CHE

Clegg LABORATORIES



entire tuning operation the input signal should be constantly monitored to keep the grid current just at zero grid current.

Typical operating conditions for maximum power output with good linearity when the amplifier is driven by an exciter that is 100% modulated with a sine wave signal is as follows:

AVG Drive Pwr (100% Sine Wave Modulated) ....2.5 watts
AVG Load Power Output.......90 watts
Peak Load Power Output......360 watts
Power Gain ....15.6 db
I_{c1} ....0 ma
I_{c2} ....26 ma
I_b ....412 ma
I_b zero signal ....150 ma

Conclusion

As an AM linear amplifier satisfactory operation in the 50-54 megacycle band was obtained delivering 90 watts output with 2.5 watts of drive.

When used as a linear amplifier for a Gonset Communicator some means of attenuating the 5 watt output of the Gonset to 2.5 watts must be used. A typical attenuator for 3 db would be a resistor T pad with 8.6 ohms in each series arm and 140 ohms in the shunt arm.

(Tests made on a borrowed Gonset Communicator indicated only 70% modulation. If this is true for all Communicators then the figures shown in paragraph above on typical operating conditions would not be as shown when a communicator is used as a driver.)

. . . W2LPC

Coil Data

L1	3 closewound turns #12, ¾" dia.
L2	4 turns #12. ¾" dia. 1⅝" long.
L3	2½ turns #16 on R3.
L4	2½ turns #16 on R2.
L5	Ohmite Z-144 RF Choke
L6	Ohmite Z-144 RF Choke
L7	6 turns (C.T.) #10, 3" long, 1" dia.
L8	3 turns #10 closewound 1" dia.
L9	Ohmite Z-25 RF Choke
9L	Ohmite Z-28 RF Choke

Letters

Dear Wayne:

I have just been made forcibly aware of the presence of three frightening members of the amateur radio community—the Know-Nothing KNovice, and his older brothers, the Technically Deficient Tech and the Generally Apathetic General. These birds are usually well-disguised as normal (Hah!) amateurs, but the astute observer can easily see them for what they are. Gradually, it seems, they are taking over ham radio, and turning it into a sort of variable-frequency Citizens Band. Rather than giving a detailed description of the three, I shall describe an encounter with a Novice/Tech of the species who lives in my apartment building. (I shall call him Harvey, because that happens to be his name.)

A few minutes ago, this Video Ranger rang my bell, was admitted (first mistake), and promptly began to fire questions at me. This is typical; I've been trying to answer his questions for many years now, but, in mid-sentence, a thought struck me. "Wait a minute," said I. "Aren't you a Tech?" In answer, he proudly pulled out a genuine Technician's license, neatly encased in plastic. His problem, I should mention at this point, was to decide whether or not he could convert his transmitter (a popular bandswitching Novice kit) to six meters. He had seen in the August—a conversion of another rig, and wondered if he could do what W1 * * * did. Now I fully approve of his spirit and desire to improve his rig, but something was wrong. Shouldn't a ham who has passed the standard theory test know enough about circuitry, reactance, and resonance to recognize two almost-identical pi-networks and compute parts values? I am reasonably sure that he got a high score on the theory test; when I asked him about capacitive reactance he could throw a formula at me, but couldn't explain what it meant. I have nothing against his not knowing, but when he has gotten a license which assumes that he DOES know something, then, as I said, something is wrong. When asked how he passed the Tech test, he said that he had merely "memorized the questions in the license manual." Further investigation revealed that he didn't really care about how his rig worked, didn't know the resistor color code and didn't want to learn it, didn't own ANY books on radio theory or operation, and just wanted me to stop bothering him with questions and show him how to put his rig on six.

How, then, does he differ from a Citizens Bander? Well, he says he has passed a test, and so implies that he knows radio theory and is entitled to look down his nose at CB'ers, little knowing that he is one at heart.

Perhaps the fault lies with him, perhaps his attitude is a product of a world of objective tests, CB'ers, license manuals, anti-intellectuals, and apathy. In any case, something should be done to make our hobby less of a breeding-ground of the Know-Nothings, the Technically Deficient, and the Generally Apathetic.

Daniel Wazcog Gardner WA2COG-WA2SOF

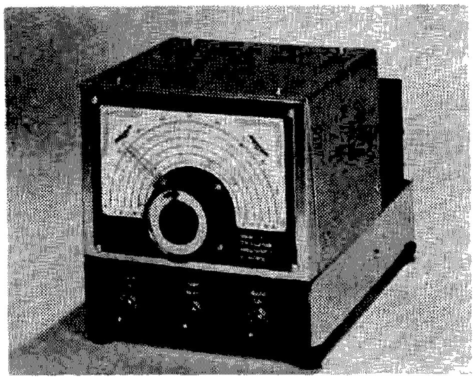
Dear OM:

I just ordered some junk from Columbia Electronics and told 'em I saw their advertisement in a magazine, like you said, but I couldn't remember which magazine. Incidentally, nobody uses expressions like "Bah!" in editorials any more. Let's see more pictures of your wife, I like her.

. . . Ken W7IDF

A Simple High Stability VFO

Fred Haines W2RWJ
123 Roberta Drive
Liverpool, New York



For several years now, the series-tuned Clapp oscillator, or variations of it, have enjoyed an almost unique position in the lore of Amateur radio. That position is deserved and has been earned through excellent electrical stability. In terms of mechanical stability, however, the Clapp circuit has added materially to the sales of foam rubber pads and shock mounts. Anyone who has constructed one of these "nervous beasties" knows exactly what I mean.

I decided to throw caution to the wind and try an old faithful Colpitts oscillator to see if something could be done about the microphonic problem. The results have been extremely gratifying, and the circuit so stable and free of mechanical shock effects, that I couldn't resist sharing my experience with others.

The circuit consists of an electron-coupled Colpitts oscillator, followed by a class A stagger-tuned buffer stage. The rf output is more than enough to drive the usual crystal oscillator circuit in existing transmitters. A voltage-regulated power supply is included on the chassis and contributes to stability vs. line voltage changes.

The oscillator is designed to cover the entire 80 and 75 meter band, from 3.5 to 4.0 mc. The higher frequency bands do not spread out over the dial, but this is not considered a disadvantage because a secondary frequency standard in the receiver is used to mark band edges and the VFO is not used as a frequency indicator.

The frequency range of oscillator V1 is 1.75 to 2.0 mc which is doubled in the plate circuit. The plate circuit of V1 is broadly resonant in the 80 meter band, L2 with its stray capacitance representing the tank circuit.

Buffer V2 is a class A stage to minimize loading effects on the frequency of the oscillator. The plate tank circuit of V2 (L3-C9) is also broadly tuned in the 80 meter band. When the tuning slugs of L2 and L3 are correctly staggered in frequency, the rf output of the VFO remains essentially constant over the entire 3.5 to 4.0 mc range.

The oscillator plate and screen circuit are supplied regulated B+ from the gas regulator, while the buffer is operated from the full unregulated output of the power supply.

Keying of the oscillator is satisfactory for 80 and 40 meter operation, although an almost imperceptible chirp is present. For more ideal characteristics on the higher frequencies, amplifier or differential keying is recommended. A switch in parallel with the key jack is used to provide a "zero beat" condition for tuning the oscillator to the desired spot in the band without energizing the transmitter.

I use the VFO as a control center for the station. A 117 volt outlet is mounted on the rear of the chassis and supplies ac power to the high voltage plate supply of the transmitter. A switch on the VFO front panel controls the ac to the outlet. Note that an interlock circuit is used so that the transmitter cannot be turned on until the VFO is energized.

Even though the high-C oscillator is much better than others in resistance to microphonics, it is desirable to take some precautions against instability. Accordingly, the VFO is built as shown in the photographs using three standard aluminum chassis as basic building blocks. The main chassis is a 7 x 11 x 2-inch unit equipped with rubber feet in the four corners. Two 5 x 7 x 2-inch chassis, mounted on edge at the front of the main base, serve as a particularly rugged basis for the shielded compartment containing the tuned circuit and other components. The two smaller chassis are fitted with an inverted "U"-shaped cover of aluminum fastened at the sides and top with self-tapping screws.

It is important to note that all heat producing components are mounted outside of the shield enclosure to prevent frequency drift due to heating effects. V1 and V2 are mounted horizontally at the rear of the enclosure so their wiring is inside the box near the turned circuit. Since there was not much room behind the enclosure for the mounting of the power transformer, VR tubes, etc., the filter capacitor can was mounted inside the shield.

The most important thing regarding mechanical stability is the mounting of the tuning capacitor, C1. It is not important what type of capacitor is used as long as it is ruggedly built, preferably with a bearing at each end of its shaft. Any dial mechanism similar to the one illustrated can be used provided it has a

73 tests the Central Electronics 200 V

Anyone who has been around ham radio for more than a few weeks has heard of Central Electronics and probably has been looking over the ads for the 200V. Time was when ham radio was split into two factions: CW and phone. Nowadays there aren't many strictly CW ops around. Sideband had a lot to do with coaxing most of the more firmly entrenched CW men into the phone ranks. And Central Electronics, in spite of the growing list of sideband equipment manufacturers, was there first and did the spade work which built the present popularity of SSB.

Ten years ago, when sideband was a hellishly complicated curiosity that we read about in QST, and there were just a few of those strange quack-quack signals on 75 meters, Wes Schum W9DYV emerged from his cellar with the prototype of the 10A exciter. This was the first well-engineered SSB exciter to appear commercially. This unit was so well done that it is as useful today as ever and you will still hear hundreds of them on the bands.

While competitors were busy imitating the 10A, Wes was back in the workshop bringing out the 10B. Next came the 20A, which was a bit more complicated and ran a bit more power . . . and a bit more expensive. Each time Wes came out with a new rig he was literally years ahead of everyone else. When he announced the 100V he scooped everyone by at least five years. Though I don't have all the actual facts, since Wes is one to keep his worries to himself, as I understand it the 100V was the straw that broke the back of Central Electronics.

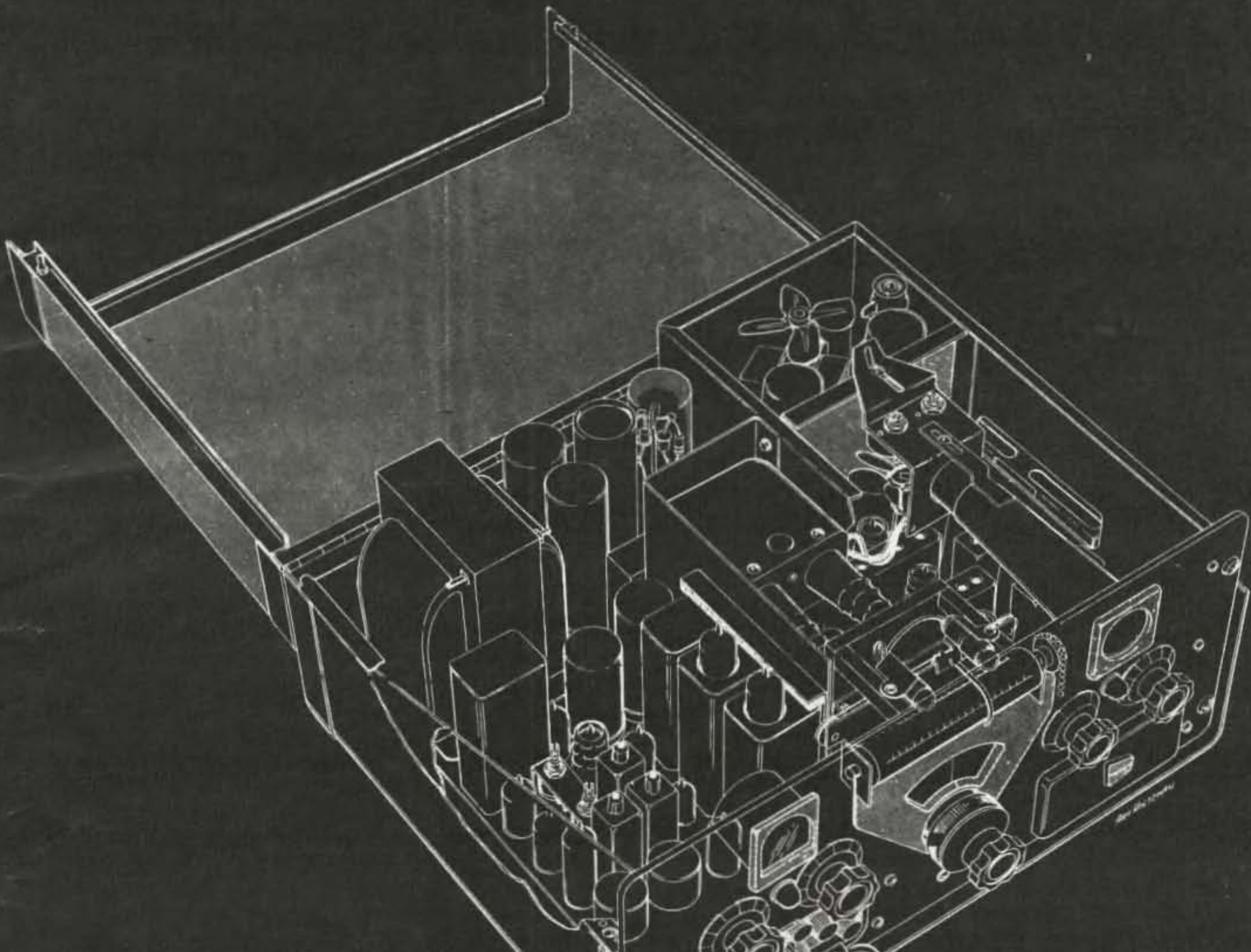
Central had grown slowly from the first cellar operation and through gradual growth had developed a nice plant. Then they designed the 100V, which was to sell for $595, in 1957. Though ads for the 100V didn't appear until about December of '57, the orders were starting to pour in. It wasnt' long until it was obvious to Wes that his plant couldn't possibly meet the demand. Just the cost of filling the orders on hand . . . let's see, 2,000 orders at a cost of about $400 per unit to build comes to about $800,000, was overwhelming. Wes tried everywhere to find some way to fill those orders, but one plan after another ended up in discouragement. The final solution was the changing of Central Electronics to a subsidiary of Zenith. Once this had been accomplished they tooled up to produce the 100V.

The 200V, born of complications due to the new $795 price, an increase in power, and complications arising from the backlog of orders for the 100V, is the latest model and is rapidly becoming as classic as the old 10A and 20A exciters.

History disposed of, let's look at the rig. The 200V is about the present-day ultimate in plug-it-in-and-operate. I made my usual scientific test by hastily throwing up a folded dipole late one night, plugging the receiver, line cord and antenna into the 200V and working every one I could hear . . . and I heard plenty. I really got behind on processing new subscriptions for a few days before the urgency of keeping 73 going overcame my enthusiasm for racking up more DX.

QST did a yeoman job of covering the electronic details of the 200V back in August (while I was too busy playing with it to write it up), so I won't go through all the circuits. A major part of the schematic appeared on our February cover. I selected this circuit because it was the most complicated one I had ever seen for any ham gear. QST spent four and a half pages analyzing it, so you can see how complicated it is. I wont' fuzz you up with a detailed tale of what the electrons do when they reach the pentode section of V11A. From an operating standpoint the 200V is the easiest to use rig ever built. You turn on the ac switch, turn to the band you want to use, set the tuning dial for the frequency and start talking. The oscilloscope on the front panel tells you if you are talking loud enough. All those dozens of knobs you usually find on a transmitter have been consolidated and hidden behind a couple of little doors. These are the set-and-forget controls.

The most important feature of the 200V is the broad-band tuning arrangement which is obviously the way a transmitter ought to be,



but is managed by a patented system which has imitators biting their nails. I remember when Central brought out their 600L linear amplifier with the first broadband coils. They were completely hidden in a cement-like lump which defied opening. One engineer told me about the company he worked for buying a 600L (after trying to buy the coils separately), removing the coil and trying to pry it apart. He ended up with a mangled mess and gave up. I doubt if Central would sell them a new coil either, so there probably is a 600L around somewhere which now has a tuned plate circuit. It is nice not to have to worry about tuning up every time you change frequency.

The more you use the 200V the more excited you get about it. True, it costs $800, but this is pretty reasonable when you consider the incredible amount of stuff they crammed into that 90 pound unit. The dial reads off in kilocycles and can be brought into calibration anywhere along the dial should the unlikely need ever arise.

The unit should hold its value well since all previous Central units still bring a good price. An RF wattmeter indicated more than rated output on all bands. Central should be able to turn these out for years.

. . . Staff

A Simple Antenna Mast

That's me putting the mast up.

THIS is for you! Yes, this is for you if you have ever wanted an antenna mast up twenty or thirty feet with no guys, no braces, and no groundpost. The mast can be moved around with ease to any location. It also has desirable applications for Field Day.

The idea is very simple. You will need one old tire, one or two bags of cement, and a two foot pipe. The amount of cement will depend on how heavy you want your base. The inside diameter of the pipe should be large enough so that the mast you plan to use can be inserted with ease.

Fill the tire with the cement and secure the two foot pipe in the center. Care must be taken to be sure that the pipe is straight.

The base should be heavy enough to support a three element beam twenty or thirty feet up. I am using it at present for a three element ten meter beam. One person can easily walk the mast up or down in seconds to work on the beam. It can also be rolled around to any convenient place in your yard when the XYL stumbles over it taking out the garbage. If the idea catches on we are going to sponsor a contest once a year to see who can get it up and down the fastest. . . . K4GSD

Over she goes. It's so easy with this simple mast.

A Versatile Automatic Keyer From Surplus

CQ de 73

Roy E. Pafenberg, W4WKM
316 Stratford Avenue
Fairfax, Virginia

Numerous amateur applications exist for an automatic CW keyer that will, on activation, send a predetermined transmission at a preset rate of speed. Just such a device was developed for use aboard military aircraft and was designed to automatically transmit a distress message from the normal aircraft transmitter. The complete equipment is nomenclatured Control Keyer Group, AN/ARA-26, and consists of Keyer, KY-65/ARA-26, and two types of remote switching stations. These units have recently been declared obsolete and have been released through MARS channels. In the normal progression of such matters, they should be available through surplus dealers in the immediate future.*

The keyer is a motor driven, code disk device that is designed to turn on the aircraft transmitter, channel it to the distress frequency and transmit the signals set up on the code disks. As supplied, two metal disks send SOS and bearing dashes and a third disk can be set up in the field to send the aircraft identification number. These blank disks are made of notched plastic and any desired CW message, within the capacity of the disk, may be formed by breaking out notched teeth. Two spare blank disks and a special setup tool are secured inside the cover of the keyer. The photographs show interior and exterior views of the keyer as supplied. The schematic of the unmodified unit is shown in Figure 1.

Several approaches to amateur utilization of this equipment are practical and the one selected will depend on the users requirements. Three conversions are covered in this article and they vary in complexity with their intended application. The first is very simple and

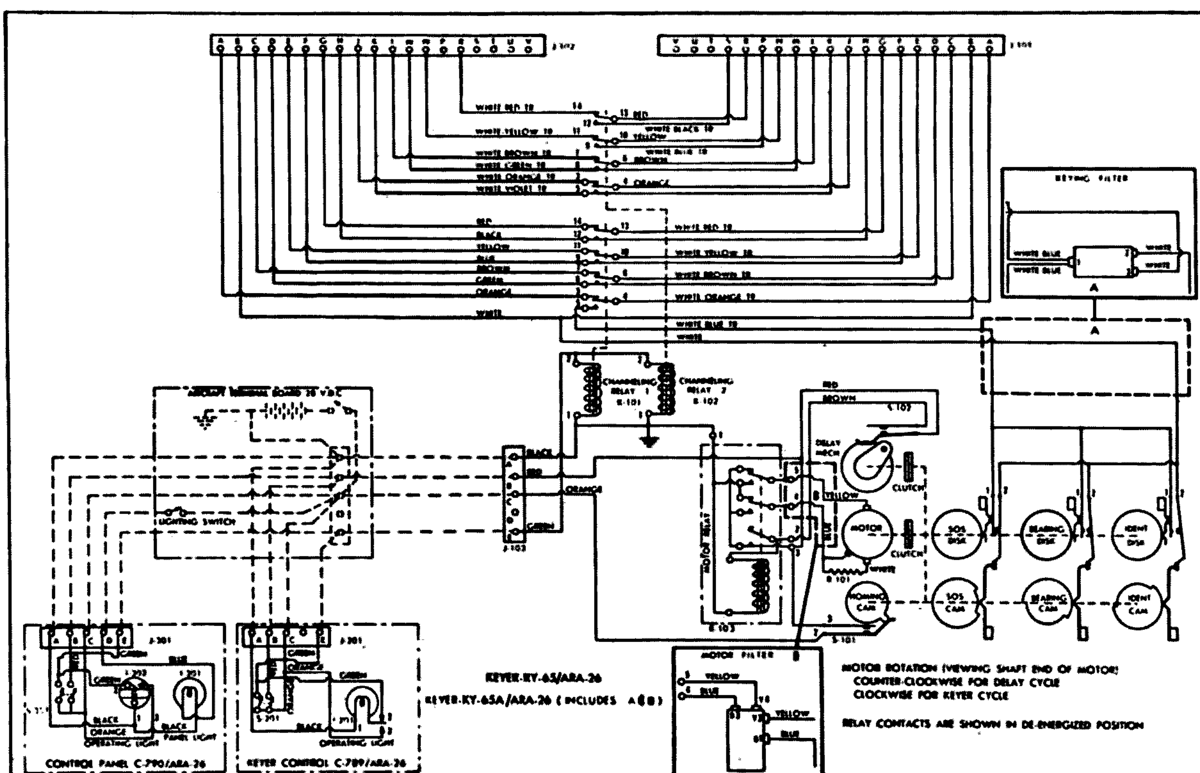
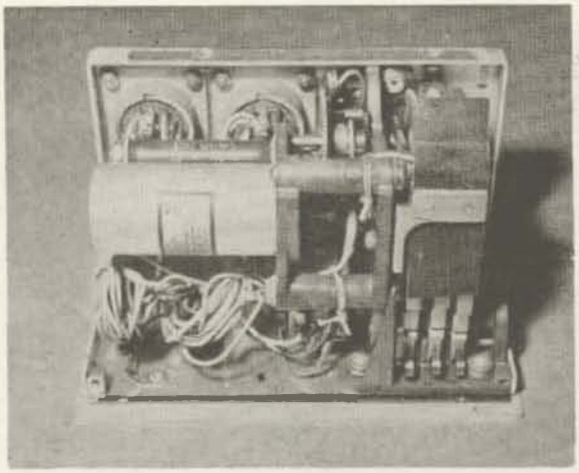


Fig. 1. Schematic diagram of KY-65/ARA-26 Keyer.



Interior of unmodified ARA-26 keyer.

its primary virtue is that it plugs in the wall and sends CW signals. The second is a deluxe automatic caller and the last is a line break operated keyer to provide automatic transmission of CW identification following radio teletype transmissions.

Each modification consists of both mechanical and electrical work. In common with most airborne equipment, a source of dc is required to operate the PM field motor and the relays. This requirement is met by the use of a slightly unorthodox but very economical, line operated, silicon rectifier supply. The mechanical work consists of replacing the metal code disks with the plastic blanks and, in the two more complex versions, rework of the disk sequencing cams and their associated contacts. This work may be accomplished with ordinary hand tools and is not particularly difficult or time consuming.

The first step is to strip the chassis and clean up the parts which will be used in the conversion. Retain all hardware for assembly of the completed keyer. Loosen the main drive unit by removing the four screws from the bottom of the case and the single screw that secures the assembly to the front panel. Locate the key contact leads and follow them to where they attach to other components. Cut these leads, leaving them as long as possible. Follow the same procedure with the yellow motor lead. Clip the blue motor lead near the housing, slip a piece of sleeving over this lead and tie to the yellow lead. This is a speed governor contact that will not be used. Unsolder the two blue leads from one end of R-101 and clean up this terminal, leaving the resistor in place with the white motor lead attached. Unsolder the leads from the homing switch, S-101, and clean up the terminals. Remove and discard the delay mechanism switch, S-102, along with its actuating lever. At the same time, remove and discard the time delay adjust ratchet spring which is mounted alongside the microswitch lever.

Remove the keying drive assembly and examine carefully. A little time devoted to study of the mechanism will prevent many problems later on. The key disks are driven by a small PM field dc motor through a gear train. Two friction clutches and a time delay mechanism were provided but they can not be utilized in this conversion since the timing gear ratio is not usefully related to that of the keyer drive. Keying is accomplished by three code disks fixed to a common shaft. These disks are made with teeth and spaces around their perimeter and are arranged to actuate the keying assembly. This assembly has three sets of contacts in parallel, each operated by a blade which contacts the association disk at all times. Only one switch operates at any given time, due to cam follower levers which always hold two of the key switch contacts open. The cam levers are operated by a set of sequence cams mounted on a common shaft along with an actuating cam which switches off the drive motor upon completion of each cycle of operation.

The cam shaft is rotated by a geneva star, which is in turn actuated by a pin permanently attached to the SOS disk. Each rotation of the keying disk shaft advances the cam shaft 1/7 of a revolution and, upon completion of one revolution, switches off the drive motor.

Replacement of the metal with plastic keying disks is necessary in each conversion and may be accomplished at this time. Remove the hairpin retaining clip and the knurled nut from the end of the code disk shaft. Loosen the set screw on the outermost disk spacer and remove the complete disk assembly from the shaft. Remove the center disk and discard it.

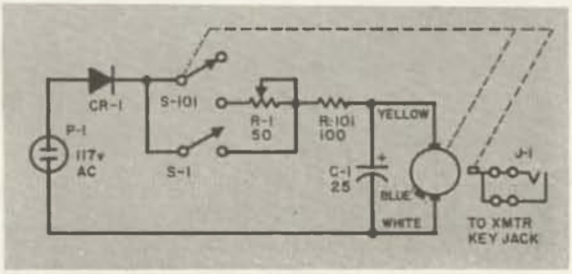


Fig. 2. Simplified Conversion.

C1—25 mfd, 50 wv dc electrolytic cond.
CR1—500 ma silicon rect.. Sarkes-Tarzian M-500 M-500
J1—Standard phone jack. Switchcraft C-11
P1—Replacement ac line cord
R1—50 ohm, 25 w variable wirewound resistor
S1—SPST normally open mom. contact push button switch
Three digit parts numbers are original components

Next, remove the center spacer and the SOS disk. Since the geneva star actuating pin is attached to the SOS disk is must be retained. File the code teeth flush with the inner perimeter of the disk and replace it on the sleeve assembly. Install a plastic disk flush against it. File the center spacer to a thickness of ⅛" and install in its original position. Install another plastic disk and the outermost spacer.

Before and after.

Line the set screw up with the hole in the sleeve and run in slightly to hold the assembly together. Mount the assembly on the drive shaft and securely tighten the set screw. Install the outer disk the thumb nut and the retaining clip. Check the unit for alignment of the disks with the contact levers and rotate the disks by hand to insure that clearance have been retained.

This completes the modification of the keyer assembly for the simplified conversion. The sequence of operation is such that the inner disk is transmitted once, the outer disk three times and the center disk three times and then the unit is switched off. Any transmission must be set up in this sequence and this lack of flexibility somewhat limits the usefulness of the stripped down version. Full flexibility, at the expense of additional work, is achieved in the other two models.

Setting up the plastic code disks is a simple task. As the photographs show, teeth are broken out of the disks to form CW characters. A tooth broken out results in key open condition and the presence of a tooth results in closure of the keying circuit. A special tool for breaking out the teeth is mounted inside the cover of the keyer. The basic code element is a dot which is represented by a single tooth. Coding is obtained by starting at the space on the disk which is marked with an arrow and continuing in a clockwise direction, breaking out teeth in the disk to obtain dots and dashes. A word of caution is advisable here. Plan your transmission carefully, keeping in mind the sequence of operation. Adhere to the following chart and perfect characters will result:

1. Leave one tooth for a dot.
2. Leave three teeth for a dash.
3. Break out one tooth for the space between two dots, a dot and a dash or two dashes in each character.
4. Break out three teeth for the space between two characters.
5. Break out five teeth for the space between words.

Preparation of the case is next on the agenda and this step applies to all models of the conversion. Remove the hardware which mounts J-101, J-102, J-103, K-101, K-102 and K-103. Clean up and retain relays K-102 and K-103. Discard the connectors and K-101, along with the wiring harness. Drill out the three rivets holding the bottom plate to the case and discard the plate. A coat of flat or semi-gloss spray lacquer will cover the existing panel markings and restore the original black crackle finish to new condition.

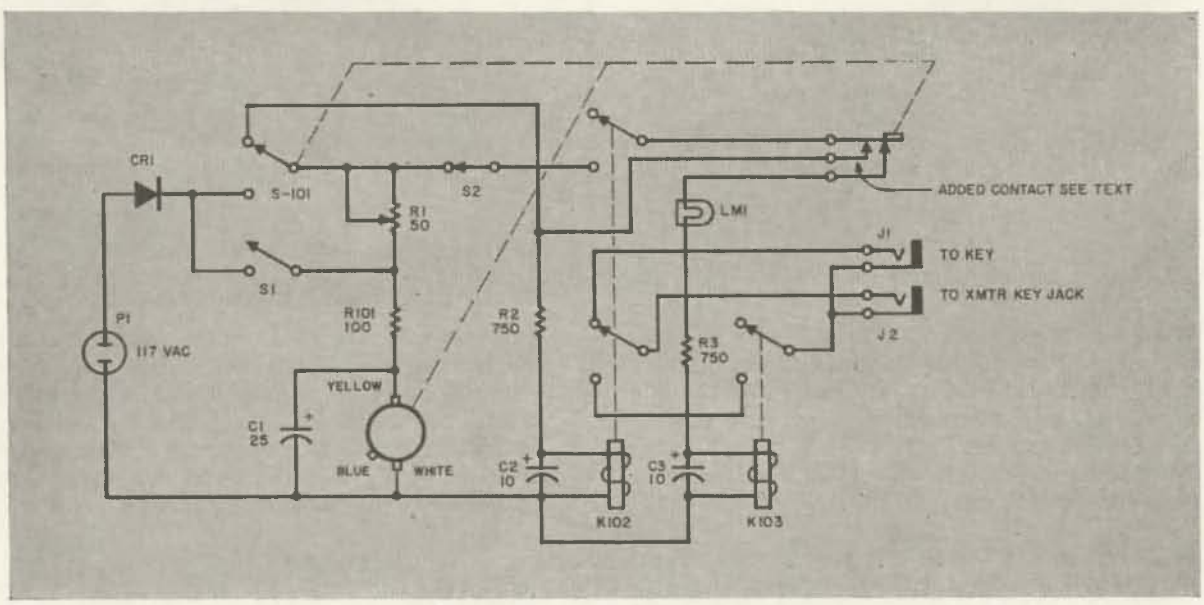


Fig. 3. De Luxe Automatic Caller.

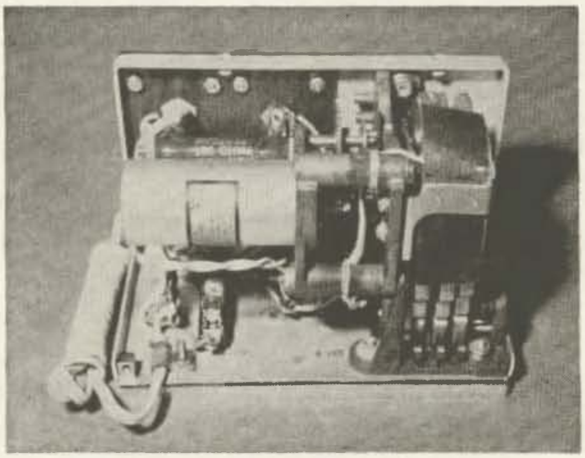
C1—25 mfd, 50 wv dc electrolytic cond.
C2, 3—10 mfd, 25wv dc electrolytic cond.
CR1—500 ma silicon rect. S-Tarzian M-500
J1, 2—Standard phone jack. Switchcraft C-11
LM1—28 v pilot lamp. GE #1829
P1—Replacement line cord.
R1—50 ohm, 25 w variable wirewound resistor
R2, 3—750 ohm. 10 w wirewound resistor
S1, 2—SPDT momentary contact push button switch
R101—Original part. 100 ohms.

Cut a piece of laminated plastic stock, 1/16" thick and approximately 3½" square. Position the plastic inside the upper right corner of the front panel and cut clearance notches for the captive nuts which are used to mount the cover to the case. Mark the location of the 12 holes that were used to mount the original connectors. Drill matching holes in the plastic and secure the sub-panel in place, using the hardware that was used to mount the connectors.

From this point on, details for each of the models differ. The following applies to the simplified version, the schematic of which is shown in Figure 2. Drill ⅜" holes in the sub-panel, centered in the three connector mounting holes. Mount the 50 ohms, 25 watt resistor, R-1, in the bottom hole and install a knob on the shaft. Mount a standard open circuit phone jack in the top left hole and a normally open momentary contact, push button switch in the top right hole. Countersink the four holes in the bottom of the case which were used to mount the drive assembly. Position the modified drive unit and install these screws along with the front panel screw. Install the silicon rectifier mounting clip, using one of the relay mounting holes. Similarly mount the capacitor, C-1, and tie points to terminate the line cord and as required for wiring convenience. Wire the unit in accordance with Figure 1, insuring that no portion of the circuit is accidently grounded.

If all appears in order, plug the unit in and press the starting switch. The drive should turn freely without binding and the key contacts should close in accordance with the keying information set in the disks. The motor speed should be smoothly adjustable from just short of stall to the point where the keyer walks across the bench.

Drill a hole in the back of the cover and install a rubber grommet to pass the line cord. Remove the name plate from the cover and give the spray lacquer treatment to the cover. Vibration may be reduced to negligible proportions by cementing a rectangular piece of



Simplified conversion. Note plastic sub-panel.

foam rubber or plastic to the bottom of the case. This completes the simplified modification which results in a commercial appearing unit that, within the limitations previously mentioned, provides excellent performance.

The two more complex modifications require additional work on the drive assembly. Manually turn the keying disks through a complete cycle and scribe the contact actuating cams at those points where the cam follower levers rest when their associated contacts are closed. Remove the three screws which secure the base support to the motor drive casting and remove the keyed shaft on which the cams are mounted. Radially drill and tap the cams, in the center of the cam bearing surface and in line with the scribe marks, to accept 2-56 machine screws.

Figure 5 shows how the cams are modified. Install 3/16", 2-56 round head machine screws in these holes, using sufficient washers to build the screw head flush with the radius of the outer cam surface. If longer screws are used, insure that they do not extend into the

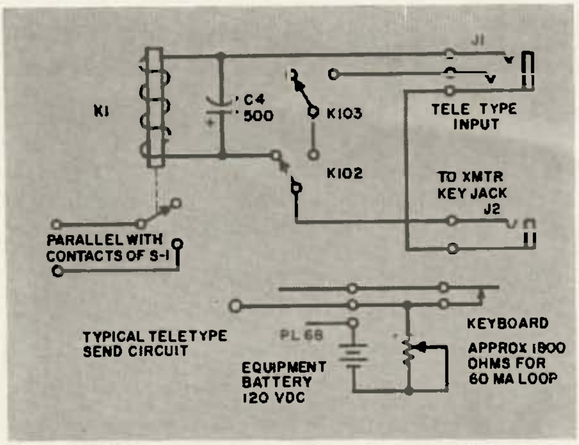


Fig. 4. Wiring changes required to convert the automatic caller in Fig. 3 to a line break operated Teletype identification keyer.

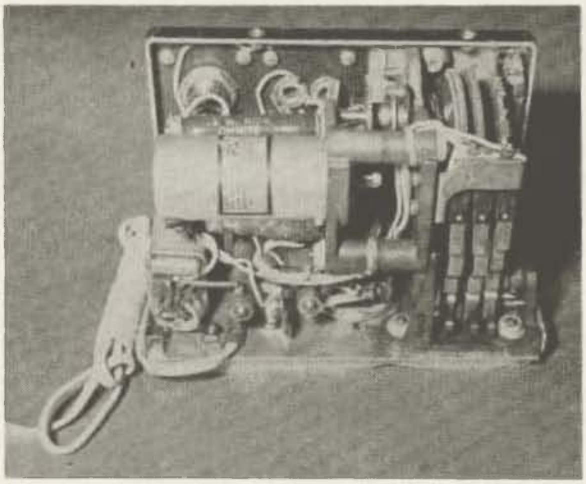
Three digit parts numbers are original parts. Schematic and parts list are identical to Fig. 3 except for input and output circuit parts and wiring changes shown above. K102 and K103 contacts are those shown in Fig. 3. Circuit shown in Teletype condition with K102 and K103 in resting position and K1 actuated.

C4—500 mfd. 25 wv dc electrolytic. C-D type BR5002
J1—Mike jack, Switchcraft type C-12B
K1—Sensitive relay, 200 ohm coil. Sigma 41F-200-S/SIL

shaft hole. File the keys which engage the shaft keyway flush with the radius of the cam shaft holes. Drill and tap a 4-40 hole in the center of the hub of each of the three cams and start a socket head set screw in each hole. Slide the cams on the shaft and reassemble the drive unit.

The cams should now be set for the desired sequence of transmission. Keep in mind that the single detent cam may be used for zero or one revolution while the other two cams

may be used for from zero to three revolutions. Rotate the keying head to neutral and advance to the first detent. Rotate the cam which is associated with the disk to be transmitted first in a counterclockwise direction until the first screw is positioned under the cam follower. Tighten the set screw which secures the hub to the shaft and then remove the screw under the cam follower. Working in a clockwise direction, remove as many 2-56 screws as keying revolutions are desired from that disk. Rotate the keyer head this number of detents and do the same for the second and third disks. Rotate the head manually and check that the desired sequence of transmission has been obtained.



De Luxe conversion.

In order to automatically transfer the keying circuit back to the hand key on completion of the desired transmission, it is necessary to add a contact to each of the three keying switches. When the end of the keying is reached, all of the cam followers are actuated and these paralleled contacts will open, transferring the keying circuit back to normal. The keyer drive will continue through the seven revolutions and stop at neutral.

Loosen the two key contact stack screws and separate the contact stack on the inner side of the outer contact. Cut mica scrap to the same shape as the existing insulator and, after slotting the screw holes, insert the insulator without removing the screws. Cut three contacts from brass stock or use very light relay contacts and slide them between the new and existing insulators. Bend and position them in such a fashion as to make with the outer contact in the transmission cycle and to break when the cam follower is actuated. Tighten the screws and rotate the head through a keying cycle to insure that the original contacts key as intended and that, for each disk, the added contacts close during the transmission cycle.

The circuit of the de luxe keyer is shown in Figure 3. Line voltage is rectified by the silicon rectifier, CR-1, and applied to the contacts of S-1 and S-101. When S-1 is momentarily closed, current is applied to the drive motor and through the normally closed contacts of S-101 to the winding of K-102. The latching contacts of K-102 close and the drive motor advances the keyer head, closing the added contacts of the key contact stack and switching S-101. At this point, the current to K-102 is applied through the normally open contacts of S-101, the normally closed contacts of S-2, the latching contacts of K-102, the added contacts of the key contact stack and R-2 to the winding of K-102. The motor drive is operated until S-101 is tripped at the end of the drive cycle and the motor stops.

The keying circuit bypasses the keyer when K-102 is in the resting position. When K-102 is actuated, the extended key is removed and the keyed contacts of K-103 are connected across the output jack, J-2. During the keying cycle, the keyer contacts supply keyed current through the lamp, LM-1, and R-3 to the winding of K-103. The keying cycle is ended by either the "off" switch, S-2, or the added contacts of the keyer head being opened. Capacitors C-1 through C-3 smooth the rectified voltage applied to the drive motor and the relays.

Some modification of the circuit of Figure 3 is required to adapt the keyer to radio Teletype use. A typical Teletype send circuit is shown in Figure 4. The input and output circuits of the keyer are wired to apply the 60 ma loop current to the keyer through the ring and sleeve contacts of J-1, through the winding of K-1 and the normally closed contacts of K-102, to the output jack, J-2. The output is patched to the transmitter where the circuit is completed by the frequency shift keyer. Relay, K-1, is actuated by the loop current and the charge of capacitor C-4 holds the contacts open during normal Teletype keying impulses.

Operation of the break key on the Teletype machine opens the loop for a period of time that allows C-4 to discharge and the contacts

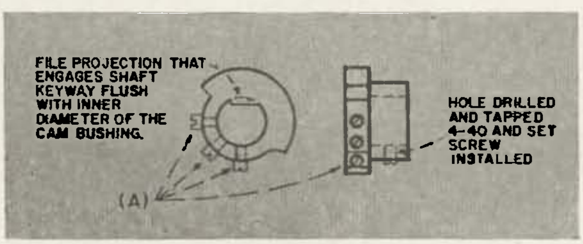


Fig. 5. Key switch cam modification. This change will allow any sequence of transmission from the three code disks. Keying cycle may be set for from one to seven revolutions of the keying head.

(A) Holes drilled and tapped 2-56 in center of cam surface. Text describes method of determining exact location. Round head machine screws are installed, using washers to build the screw head out flush with the outer circumference of the cam surface.

of K-1 to close. This starts the keying cycle and K-102 is actuated. Loop battery is then supplied through the tip contact of J-1, through the CW keyed contacts of K-103, to J-2 and hence to the transmitter. Completion of the keying cycle releases K-102 and the circuit is restored to normal Teletype operation. It is essential that the ac input to the keyer be routed through the loop battery power supply switch. If this is not done, switching the power supply off would cause the keyer to run continuously.

The photographs show construction details of the de luxe versions of the keyer. Mount the variable resistor in the bottom, J-1 and J-2 in the top left and the indicator pilot in the top right connector clearance holes. The relays mount in their original positions and the other components are mounted as they can be squeezed in. Use of miniature transistor circuit capacitors for C-2 and C-3 permits their being mounted on the relay terminals. C-1 may be mounted under the stud which secures R-101 to the motor drive casting.

Wiring is straightforward and the layout of the original harness can serve as a guide for routing. Decals and the finish details described for the simplified version will dress these units up and result in assemblies that are indistinguishable from factory products. Operation of the keyers is trouble free and they, in addition to their novelty attraction in producing contacts, are genuine assets in any operating room.

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*Both Columbia Electronics Sales and J. J. Candee Company have plenty of the ARA-26 units in stock. R-W Electronics did have a few but we wiped out their supply stocking up the "73" lab. The following non-advertising (so far) surplus dealers also have indicated that they have them in stock: C&H Sales; Bill Slep Company; Tri-County Electronics.

Junk Box

My cellar and garages are famous all over Brooklyn for the twenty-five year collection of radio debris that has accumulated. Naturally I have occasional visitors whose eyes bug out and who pay re-visits when they need something for some gadget they are building. This does not always work out to their advantage, as Stan WA2BGA found out to his bewilderment the other day. He dropped in to "borrow" some coils for a little receiver he was whipping up. I dug out some oldies, blew the dust off 'em, and said a sorrowful goodbye. I needn't have worried so about it for they were back in a couple hours in the hands of an irate Stan. "Take back your old fashioned coils . . . all I can get with 'em is Little Orphan Annie and Just Plain Bill." . . . NSD

A Like-New Mixer Circuit

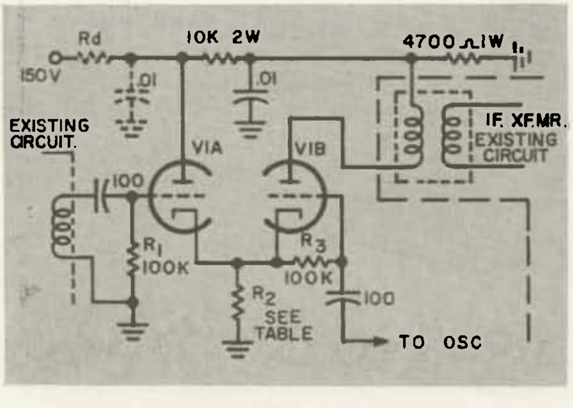
WOULD you like to improve the sensitivity and the stability of your receiver?

If you would, and don't mind delving underneath the chassis a bit, one of the quickest routes is to modify front-end circuitry. The technical article, "Up Front," in our March issue contained a rather complete collection of improved front-end circuits.

However, here's one which escaped attention when the article was prepared—and which has escaped almost everyone's attention since it was first developed. That's why we're calling it a "like-new" circuit; it's been around for a spell but it might as well be new since almost no one knows of its existence.

Before going into this circuit, it might be well to review the characteristics of a good mixer. The ideal mixer in a superhet receiver should (1) produce no spurious frequencies, (2) provide ample gain for the signal, (3) contribute no noise to the signal, (4) provide complete isolation between oscillator and signal to prevent undesired radiation, and (5) present as light a load as possible to the oscillator to preserve frequency stability.

These characteristics, at least to a degree, are mutually incompatible with most conventional circuits. For instance, isolation of the oscillator from the signal circuit usually requires screening grids in the mixer tube, which in turn raise the mixer noise level and violate objective 3.



As pointed out in our aforementioned technical article, the best compromise to date has been the 6AC7 used as a pentode mixer, following the circuit described in Langford-Smith[1]. This circuit provided low noise, adequate gain, little in the way of spurious output, and adequate isolation for most purposes.

However, the particular version of the twin-triode cathode-coupled mixer which we're describing here outdoes the 6AC7 on all counts except gain, and runs it a close race there. On top of this, it can be installed in any set which uses an octal-base, a 9-pin, or a 7-pin mixer tube without changing the socket, since suitable twin triodes are available in all three basings.

The circuit is not original; it was found in K. A. Pullen's book "Conductance Design of Active Circuits," a volume[2] which incidentally should be in the library of every serious ham designer (plug unsolicited; Radio Bookshop please copy), and was field-tested in a vintage BC-779 in comparison with both a 6L7 and a 6AC7.

Results were judged on a purely subjective basis, due to lack of test instruments suitable for adequate and accurate measurements. numerical values mentioned here are calculated figures, but the field tests confirm them as closely as possible.

The full circuit is shown in the schematic, Fig. 1, Table I lists parts values and operating conditions which vary with different tube types or design objectives.

At first glance, you may be led to believe that this is approximately the same circuit as that recommended by Geisler[3] or Lee[4], or may be a version of the Crosby triple-triode product detector[5]. While the general configuration is similar, the circuit operation and its advantages are radically different.

The key point is the low value of plate voltage supplied to V1B. Pullen recommends only that V1B's plate supply be "considerably" lower than that for V1A. The best operation was found with 50- and 150-volt supplies, re-

spectively, and component values shown are for use with these voltages.

By operating the two nominally-identical triode sections with a common cathode resistor but at two different plate-supply voltages, a relatively small change in current in one tube will cause a large change in the gain of the other. This is accomplished without sacrificing average gain in either tube.

In addition, the cathode-follower action of each stage completely isolates the oscillator from the signal circuit. Since the signal sees only a pair of triodes, noise is not increased.

This circuit is a true linear mixer rather than a detector; its output contains only the two original frequencies and the "product" of the original signals (numerically equal to the sum and difference frequencies but without their usual noise content). The chain of spurious frequencies usually found in detection-type mixer circuits is absent.

Those who have tried triode mixers before, even of the cathode-coupled variety, may wonder about gain. Calculations showed that the version first tested should have shown a conversion gain of about 20, as compared to the calculated pentagrid mixer gain of about 5 under the same conditions.

The test signal was a broadcast station with consistent strength. S-meter reading with the pentagrid mixer was recorded and the twin-triode circuit then substituted and mixer alignment readjusted. The S-meter showed just under 2 units improvement.

Considering the free-wheeling calibration of most S-meters, and this one was no exception, this is a remarkable correlation of theory and experiment. Frankly, we disbelieved it and substituted another tube which had a calculated gain of 13. After realignment, the S-meter dropped one unit.

Regardless of such gain figures, which are dependent on many variables not all of which are under control, this version of the twin-triode mixer shows more signal gain than many pentagrid mixers. Its noise figure is so low that mixer noise simply disappears, even with three *if* stages following. The result is almost complete silence between stations, leading one to believe at first that the circuit is a dud. Then, though, a fading long-hop signal will come through, moving almost instantly out of the no-signal region into clear audibility, and the design is vindicated.

Every type of twin-triode tube tested to date works in this circuit, but some give better results than others. As noted in Table I, oscillator injection voltage requirements vary drastically from tube to tube. In a like manner, sensitivity varies.

Among octal-base tubes, the 6SN7 gives greatest gain but requires higher voltages to get there. The 6SL7 develops its gain (just half an S-unit less) with much weaker signals and much less oscillator injection. Therefore,

Table I. Voltage Requirements for Various Tubes and Values of R2 With Typical Conversion Gain

Tube	6SN7 (also 12AX7)			6SL7 (also 12AU7)			12AT7			6J6	
Value of R2	100	500	1000	100	500	1000	100	500	1000	100	1000
Input—Voltage (Signal)	2.1	10.5	21	0.32	1.6	3.2	1.4	7.0	14.0	2.1	21
Input—Voltage (Osc.)	2.5	11.5	22.4	0.42	1.9	3.6	1.6	7.0	13.1	2.3	22
Conversion—Gain if IF Xfmr Impedance Is 50K ohms (For Comparison)	18.5	18.3	18.0	13.9	13.7	13.6	100	150	160	80	130

the 6SL7 is recommended.

Dozens of twin triodes are available on 9-pin bases; among the most popular are the 12AX7, the 12AU7, and the 12AT7.

The 12AX7 is directly comparable with the 6SL7, and the 'AU7 with the 'SN7. However, the 12AT7 is the hottest tube available for this circuit, with a gain of more than 100 and comparatively low injection- and signal-voltage requirements, so it's the only recommended type. If you're willing to change sockets, the 12AT7 is the best for any set regardless of original tube type.

In the 7-pin basing, there's only one choice —the 6J6. Aside from the fact that the 6J6 is the only 7-pin twin triode easily available, it is surpassed only by the 12AT7. Gain is in the neighborhood of 100 (see Table I).

The entire circuit is simplicity itself to install. Remove all old connections from the mixer-tube socket, being careful not to cut short either the grid lead from the tuning coil or the plate lead from the *if* can. Then rewire according to the schematic.

If you don't have +150 vdc available in your receiver (many don't, install resistor R_d and its bypass capacitor (shown on the schematic in dotted lines. Value of R_d must be determined by trial and error. Start with 50K ohms, and work down until you find the resistor which gives 150 volts at point A after everything has warmed up.

With the new mixer installed, you'll have to realign the mixer tuned circuits. The cathode-follower inputs reduce input capacity so drastically as to completely detune the stage, so don't be surprised if nothing comes through at first.

The input capacity change has least effect at the low end of any band, so it's best to reverse normal alignment procedure and start by adjusting the *trimmer capacitors* in the tuning assembly at the *low end*. Simply adjust for maximum signal strength (or higher S-meter reading).

Next, tune to the high end of the band and rock the trimmer slightly to see if the adjustment is optimum. If not, adjust the trimmer again for the best high-end signal strength.

If the high and required adjustment, return to the low end but this time adjust the coil slug for maximum signal. Then return to the high end and readjust the trimmer. You may have to repeat this slug-at-low end-and-trimmer-at-high-end procedure several times to restore tracking, since the change in input capacity usually amounts to about 10 mmfd, which upsets original tracking adjustments. However, with patience the tracking can be made to surpass the original condition.

For the theory-minded, here's how this mixer operates:

First, imagine that the second half of the tube, V1B, is not in the circuit at all. Signal voltage supplied to the grid of V1A varies the tube's plate current, and this variation of current through cathode resistor R2 varies the instantaneous voltage from the cathode end of R2 to ground.

Now add V1B to the circuit, but keep the oscillator turned off. The circuit is now a cathode-coupled amplifier. Since it is biased to operate in a linear region, the only output frequency is the signal frequency, which is bypassed to ground through the *if* transformer. Output is nil.

Remove the signal voltage from V1A, apply the oscillator voltage to V1B, and the situation is reversed. Now V1B is the cathode follower and V1A the grounded-grid amplifier (with no load in the plate circuit). Output is still zero.

With both signal and oscillator voltages applied, the situation changes. V1B is a grounded-grid amplifier for the signal, but its bias is being changed also by the oscillator signal and as a result its gain varies from zero (at cutoff) to maximum (zero bias) at the oscillator frequency.

Thus, at the instant when signal voltage is high and oscillator voltage is low, V1B will have maximum gain and output will be high. If oscillator voltage is high at that instant, output will be low because V1B's gain will be zero.

This can be expressed mathematically too: The gain of two cascaded amplifiers is equal to the product of their individual gains. That is, $K_{total} = K_1 \times K_2$. In this circuit, K_1 is equal to the gain of V1A and K_2 is equal to the gain of V1B.

However, gain is equal to the product of the tube's mutual conductance and the effective load resistance, and the mutual conductance of a tube is determined in part by its grid bias. If this bias is changing at a rapid rate, as it is in this circuit, the gain will be equal to average gain times the rate at which

bias changes, or $K_2 = K_{2av} \times F_{osc}$.

Plugging this equasion back into the original total gain equation gives us $K_{total} = K_1 \times K_{2av} \times F_{osc}$.

Since the output signal is, by definition, equal to the input signal times the total gain, we have for an input signal F_{sig} an output of $K_1 \times K_{2av} \times F_{osc} \times F_{sig}$, and since AC signals are *vector* rather than *scalar* quantities the indicated multiplication must be carried out by vector rather than by straight arithmetic methods. The result is that the output consists of the original two frequencies, the numerical sum of the original frequencies, the numerical differences, *and nothing more.*

Getting away from the exotic mathematics, the big difference between this process and detection-type mixing using non-linear devices such as diodes or overdriven tubes is that *only* four output frequencies are present. Harmonics and spurious outputs are not.

In addition, the cathode follower is far more tolerant of overload than is any other basic amplifier circuit, and as a result no clipping or distortion occurs in the mixer.

A common problem with many conventional mixers is cross-modulation, in which two carriers become "intertwined" and an unwanted signal rides in on the one you want.

Even under extreme conditions, such as local injection of a signal strong enough to almost block the *if* strip, cross-modulation could not be induced in this mixer. Apparently this is another by-product of its unusual method of operation.

Although no tests have yet been made, Pullen's analysis of the circuit indicates that it should provide a good high-output product detector for converting SSB and CW to audible signals; simple substitution of an RC coupling network (or an audio transformer) for the *if* transformer is the only circuit change, though you might want to increase the value of resistor R2.

In summary, this overlooked mixer circuit appears to offer extreme advantages over more-conventional circuits in all of the five characteristics of the ideal mixer, with fewer parts than usually required. It works as well in the set as it does "on paper" in the design stage, and can easily be adapted to any receiver. Try it, and let us know how it works for you.

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3. Geisler, Leonard, "Souping The Super-Pro," CQ Magazine, December, 1957, page 30.
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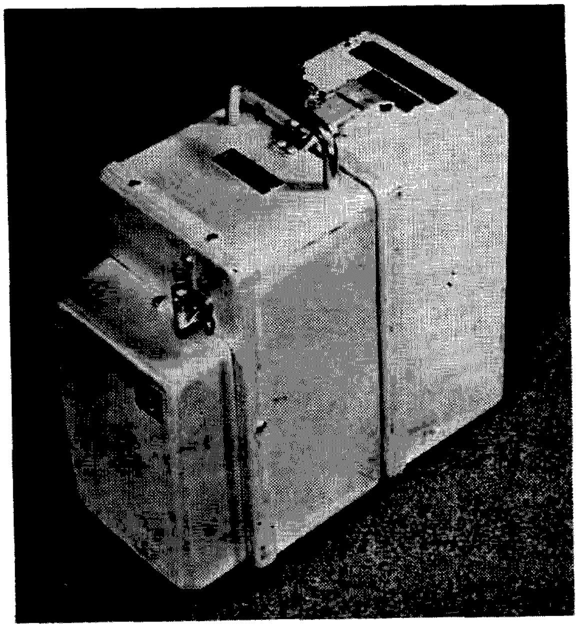
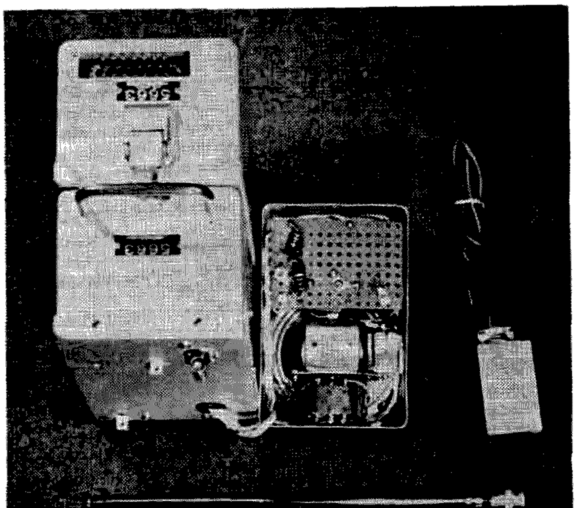


Two Meters the Easy Way

Photo Credit: Morgan S. Gassman, Jr

Today's "best buy" in 2 meter equipment is available on the surplus market as a government agency variation of the famous Bendix MRT-9 Packset. This VHF transceiver is available from Metro Electronics Corporation, 172 Washington Street, New York 7, N. Y., at a cost of $24.95. This is a real bargain by any standards since the wholesale cost of the tubes alone exceeds $65.00. The dual considerations of high performance and low cost, coupled with an easy conversion, make the sky the limit for amateur application of this equipment.



Since few details are available on the government application of the transceiver, the equipment is best presented by describing the commercial prototype and then outlining the specific charges found in the surplus version. The Bendix MRT-9 Packset was a very compact, high performance FM transceiver, operating in the 152-174 megacycle band and designed to meet all FCC requirements for this service. The equipment used 19 subminiature tubes and was powered by dry batteries or by a 2 volt, vibrator power supply. Figure 1 shows a block diagram of the prototype equipment and the performance more than justifies the complexity of the circuit. Power output of the transmitter was 1 watt and the receiver sensitivity exceeded .5 microvolt.

The surplus version of the transceiver was modified in production for a telemetering application and is shown in the photograph. While the circuit changes are not too extensive, the mode of operation and the control circuitry are changed considerably. Specific differences are as follows.

1. The second operating channel is deleted and V202 is wired as an audio oscillator.
2. The squelch circuit is deleted and V112 is changed to a 1AH4 and wired as a 1st audio amplifier for the receiver section.
3. A receive audio tone filter has been installed in an enclosure secured to the front panel of the equipment.
4. Crystals for operation on 138.06 megacycles are supplied and the tuned circuits are padded for operation on this frequency. This provides for operation on 2 meters with no further change of the tuned circuits.
5. A 6 volt vibrator power supply is housed in the former battery compartment.

The transceiver shown in the photograph is modified for AM operation in the 2 meter band. This conversion is relatively simple and should be easily duplicated. AGC voltage is obtained from the DC component developed across the 1st limiter grid resistor. The audio component developed across the 2nd limiter grid resistor provides AM detection. A power transistor audio stage is installed in the ex-filter compartment along with a PM speaker and the combination audio output-modulation transformer. Also included in the compartment are the send and receive audio gain controls, the carbon mike input circuit and a send-receive

relay. The power supply is used as is and requires no modification for 6 volt DC operation.

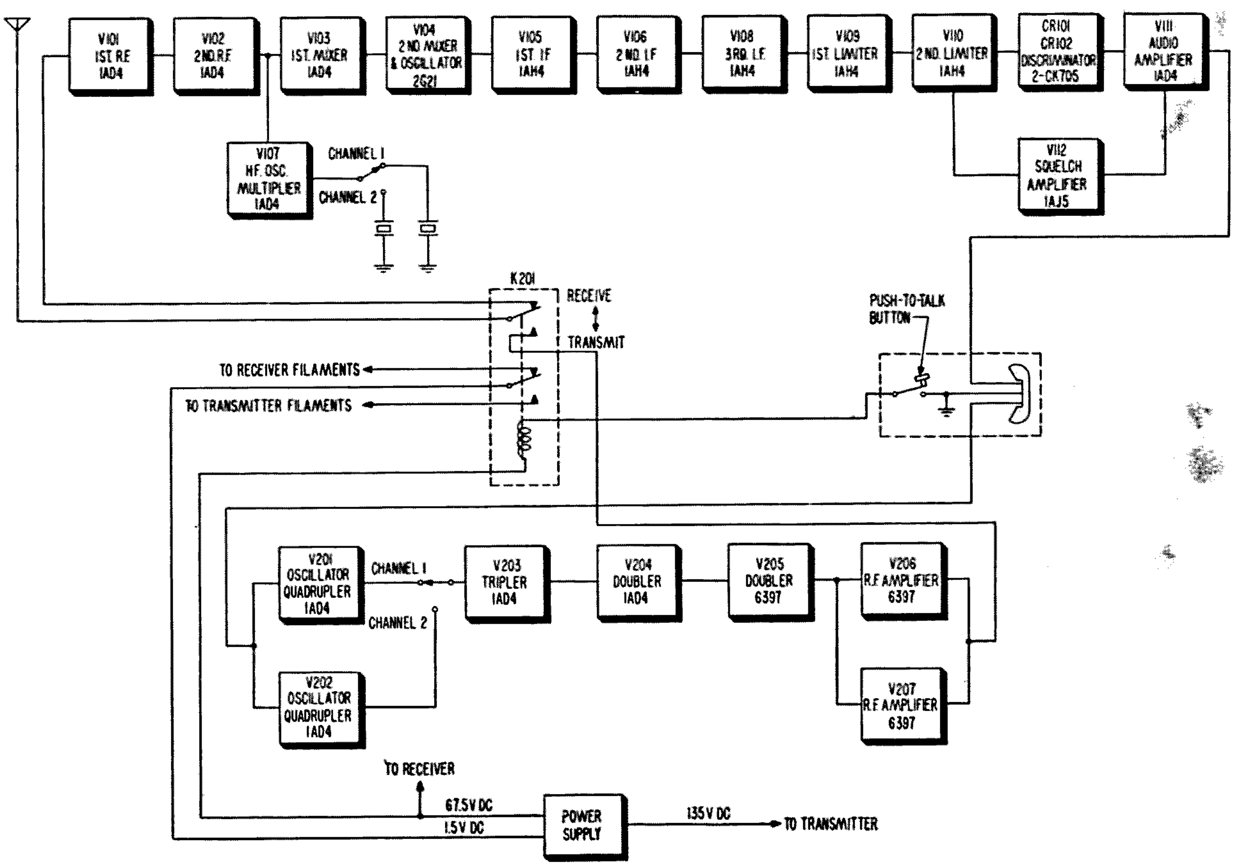
Crystals for the converted equipment pose no problem. International Crystal Manufacturing Company has correlation data on hand for this equipment and can provide one day service on small orders. Cost is reasonable, $5.75 for the transmit and $6.50 for the receive crystal units.

Since technical data on the surplus transceiver is simply not available, it was necessary, in writing up this conversion, to describe the equipment in much greater detail than would otherwise be required. A detailed description of the project, including schematics, layout drawings, conversion instructions, crystal data and alignment instructions, was prepared in the form of an article for publication in 73 Magazine. However, space limitations, particulary for presentation of the large schematics, make it impossible to print the article in a regular issue.

In view of the heavy demand for detailed information on this surplus transceiver, the editor has decided to print the full article in a separate booklet and make it available through 73 Magazine. Cost per copy of this special printing is $.50 and, as Wayne says, "If we can break even on the deal, we will be happy."

This little transceiver is, at its price, one of the most attractive buys on the surplus market. Modified as described, it will meet the individual amateurs requirements for a fixed frequency, battery powered transceiver and for emergency or club net operation it is ideal.

. . . W4WXM



A Useful Accessory for the Ham Shack

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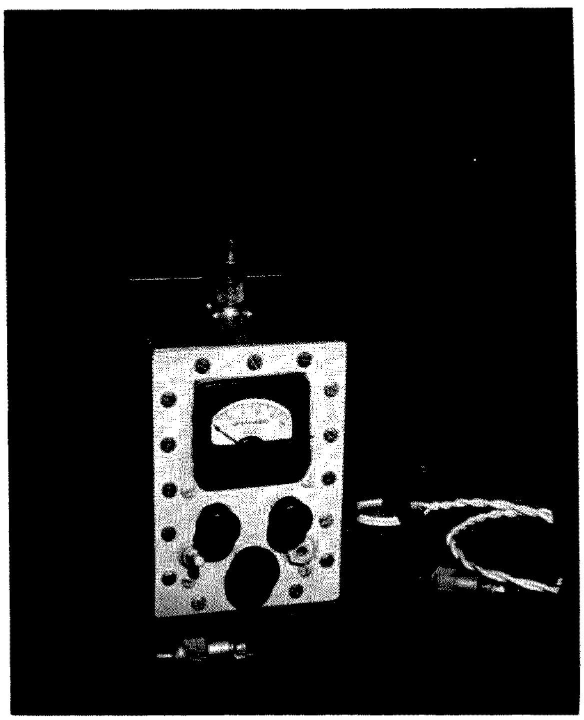
Because we are dealing with something we cannot see, namely electrons and electromagnetic radiation (we only see their effects), we must acquire the ability to use test equipment, in order to understand and find our way in this invisible realm.

The piece of test equipment about to be described is one of the more useful instruments that the amateur should have in the shack. While this instrument serves primarily as a field strength meter, it will also serve as a phone monitor, neutralization indicator and a sensitive wavemeter.

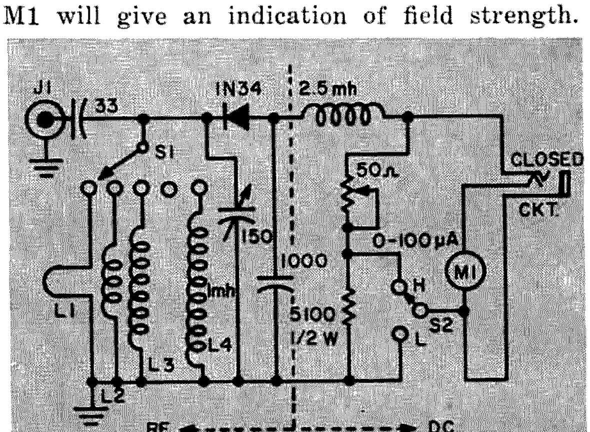


Referring to the circuit diagram, meter M1 is a sensitive instrument which indicates the pressure of rf when the device is used as a field strength meter, wavemeter or neutralization indicator.

To use this instrument as a wavemeter, a pickup loop is substituted for the short whip antenna at the top. Switch S1, the band switch on the right of the panel, is placed on the proper position. Coil L1 tunes the vhf range of approximately 90 mc to 170 mc (2 meters). L2 tunes 28 mc to 100 mc (10 meter and six meter bands). L3 tunes to 7 mc to 30 mc (40, 20, 15 and 10 meter bands). L4 tunes from 2 mc to 7 mc (80 and 40 meter bands). With switch S1 on the proper tap, condenser C2, on left of panel, is used to peak the reading on meter M1. Using a calibrated dial, frequency may be read directly. Toggle switch S2 is a high-low range switch for meter M1, providing a means of keeping the meter on scale and protecting it against burn-out. Potentiometer R1 (center of panel) is a vernier shunt control, also for keeping the meter on scale.

For use as a phone monitor, rf should be fed into the input jack with a link or pick-up wire. Once again the LC circuit is resonated to the frequency we desire. Earphones inserted in jack J2 will open the meter circuit and allow you to monitor the signal. Switch S2 is placed in the Hi position.

Field strength readings can be taken by using a short pickup antenna. Again the LC circuit should be tuned to resonance. Meter M1 will give an indication of field strength.



With switch S2 in the Hi position the meter is very sensitive and potentiometer R1 is a variable shunt providing much range of scale adjustment. For use as a remote reading field strength meter an external microammeter (with up to 200 feet of wire) may be plugged into J2. For making transmitter adjustments

this is a very desirable feature.

Now notice that one position on the bandswitch S1 is vacant, this vacant position provides a very broad band—low sensitivity position for those extremely high rf fields where even R1 and S2 cannot provide enough attenuation.

Neutralization measurements are made by coupling the instrument through a pick-up link to the tank coil involved, with S2 in the Lo position. When the instrument is tuned to resonance it becomes a very sensitive rf indicator. It is so sensitive that it will readily be seen that complete neutralization exists in theory only.

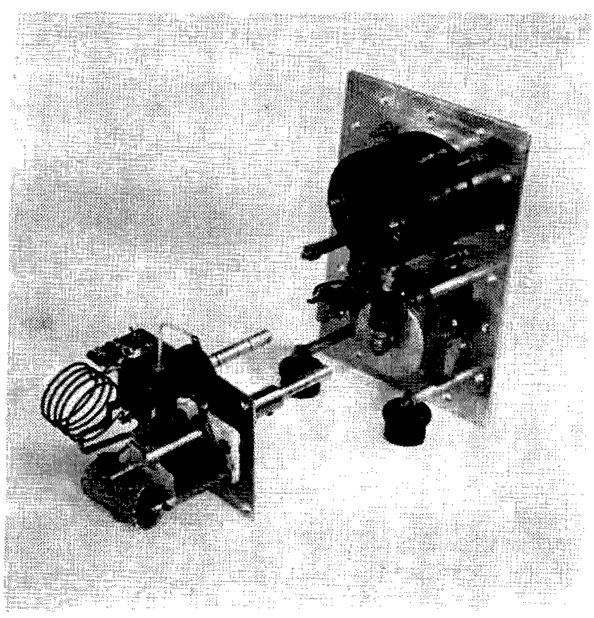
As in all simple gadgets there are a few simple construction techniques which make the difference between gadget and instrument. In this case the important thing to keep in mind is that from the antenna to the crystal is the rf portion, and from the crystal to the jack J2 is the dc portion (with audio superimposed). With this in mind, construction is such that the two parts are separated, thereby giving some measure of protection from rf energy to the very sensitive microammeter M1. Also note the extensive use of sheet metal screws on the aluminum case. The only rf we want to enter the case is the rf we are attempting to measure via the antenna jack. Note again, we have here an instrument for detecting electromagnetic radiation, from approximately 170 mc to 2 mc. We now have an instrument for visualizing what cannot be seen.

The usefulness of this instrument is limited only to one's ability to apply it and interpret the results it gives. These only come with experience, trial and error and determined application.

. . . **W2WXH/6**

Coil Data

L1—One turn hairpin loop.
L2—5 turns of #18 enamel wire space wound 1" dia.
L3—24 turns #22 cloth covered wire, close wound, 5/8" dia.



An Inexpensive Vertical

Ken Johnson W6NKE
21835 Rodax Street
Cauoga Park, Calif.

THIS antenna was born of the lack of space and money and a desire for simplicity. It not only satisfied these requirements but proved to be one of the best DX getters that I have ever built in more than twenty-five years of hamming. It requires no radials and feeding and loading are accomplished at ground level. It can be mounted on the side of a house (Fig. 1) and is so designed that the top half is self-supporting. The majority of the materials are aircraft surplus and the total cost of the system is around fifteen dollars.

The radiator consists of three twelve foot sections of surplus aluminum aircraft tubing, three aircraft tubing clamps and a fifteen foot piece of ¾ inch diameter round cedar pole. In the original antenna, the bottom tube section measured one inch O.D., ⅞ inch I.D.; the mid section was ⅞ inch O.D. and ¾ inch I.D. The top section had an O.D. of ¾ inch. These diameters allow the sections to be telescoped together in the final assembly of the radiator.

Slot one end of the bottom and mid sections of tubing for a distance of one inch. This can be easily done with a hack saw.

Loosely install one of the tubing clamps on the slotted end of the mid section and insert one and one-half feet of the top section into it. Tighten the clamp until a good mechanical and electrical joint is produced. Care should be taken to remove any protective coating, such as anodize, from the area of the joint. This can be done by cleaning the contact point on the top section and an inch or two of the interior of the mid section with emery cloth.

Next, insert the cedar pole into the opposite end of the mid section and run it through the tubing until it butts against the end of the top section. Drive four small finishing nails through the wall of the mid section and into the pole near the lower end. This will hold the stiffener pole in its proper place.

Loosely install another tubing clamp on the slotted end of the bottom section of tubing. Insert the protruding end of the pole and the mid section tube into this end of the bottom section. Adjust this slip joint until the overall length of the radiator measures 33 feet, then tighten the clamp. Again, be sure to remove any anodize or protective coating from the tubing to insure a good electrical connection.

Clean an inch or two of the outside of the lower end of the bottom section, install the third clamp and tighten. This will later serve as a feed connection when the antenna is raised to a vertical position.

The next step is to install the ground pipe but before this can be done, the exact location of the antenna must be determined. As it was previously stated, the antenna was designed to mount on the side of a house. The peak of a roof is ideal for the top mounting insulator and another one should be located approximately three feet below it.

Assuming you are going to use the peak of the roof, install a standoff insulator at that point. Tie a length of string with a weight or plumb bob at the end of it to the insulator and mark

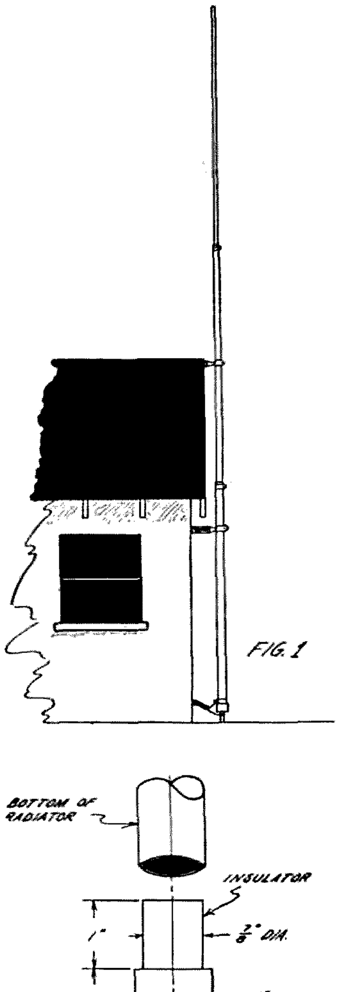
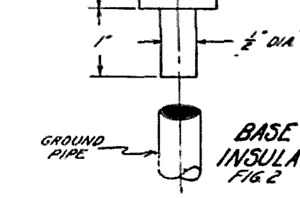
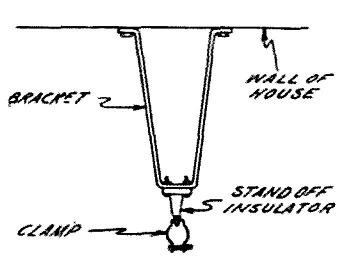


FIG. 1



BASE INSULATOR
FIG. 2



WALL BRACKET
FIG. 3

the spot where the weight touches the ground. This is the spot for the installation of your ground pipe.

Thread one end of a piece of one-half inch galvanized pipe twelve feet long and install a pipe to garden hose adapter. File the opposite end of the pipe until it is somewhat sharp. Attach the garden hose and have a friend on top of a step ladder help you hold the pipe vertical with its sharpened end on the spot indicated by the plumb line.

At this point, a word of warning is appropriate. The first foot of the next operation is extremely wet and muddy, so be sure and wear your oldest clothes.

Have someone turn the water pressure on full. keep your mouth closed and wash the pipe down into the ground. If you should strike rocks, work the pipe gently up and down until enough earth is washed away to allow the rock to move and the pipe to pass. Continue this process until approximately eight inches of pipe are still above the ground.

The usual procedure at this point is to turn off the hose and head for the shower.

The next job is to fabricate some kind of separating insulator. The original one was a piece of micarta filed to a point on either end. The present one is machined from a piece of plastic round stock (Fig. 2).

With the plumb line still in place, measure the distance from the wall of the house to the line. From this dimension, figure the size of the wall mounting bracket necessary to compensate for the overhang of the roof as shown in Fig. 3. This bracket can be made of one-eighth inch by one-inch strap iron and can be bent to the proper shape in a vise.

Mount the bracket to the wall of the house with lag or toggle bolts approximately three feet below the top insulator at the peak of the roof.

Two large size fuse clamps were used to clamp the radiator to the standoff insulators. These can be purchased at any electrical supply house.

At this point, you are ready to erect the radiator. Install the base insulator on the ground pipe and raise the radiator to a vertical position. Snap it into the fuse clamps on the standoff insulators and place the bottom end over the top of the base insulator. Insert the screws through the ears of the fuse clamps and tighten them, locking your vertical in place.

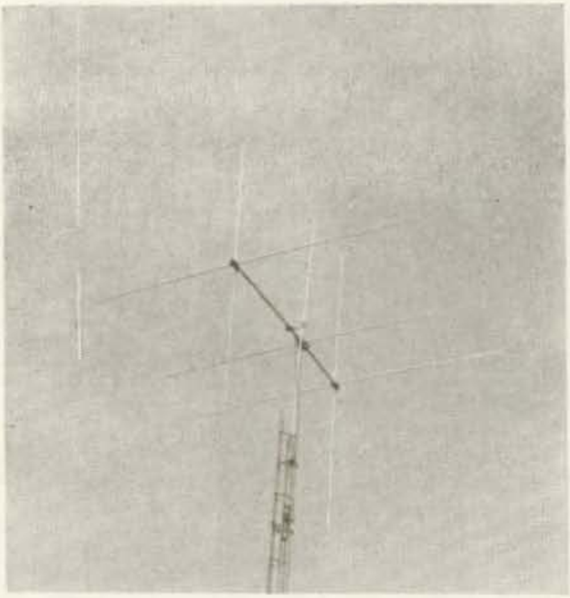
This antenna is fed with 52 ohm, RG58U or RG8U coax cable. For operation on 40 and 15 meters, the center lead is connected to the radiator by installing an alligator clip to its end which, in turn, is snipped on to the clamp at its base. The coax shield is connected to the ground pipe by means of a ground clamp.

For operation on 80 meters, an air wound loading coil of 15 turns of #14 wire, three inches in diameter, is used. The top of this coil is connected to the base of the vertical with a small battery clamp. The alligator clip on the center lead of the coax is then snipped on to the coil at approximately the twelfth turn.

The SWR on the original antenna was below 2:1 on all three bands.

With 75 watts and this antenna, the writer worked Europe, Asia, Oceania and South America on 15 meter CW. Numerous other dx contacts were made on 40 and 80 meter CW.

With patience and favorable conditions, you, too, will find that this antenna will get the job done. When you get your General Class license, you will find that it will do well on the phone bands too. It's an all around good antenna for an all around good ham. . . . **W6NKE**



George Messenger, K6CT
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West Covina, California

A New Antenna Design

Part II

Dual Diversity Beam

In the September issue of "73" I described the design concept and the performance of the cross-polarized beam. This article will describe the antenna itself and the factors that influenced the design details.

Essentially, it is two Gamma-match fed Yagis on a single boom, one of them in the horizontal plane and the other vertical. No single part of the physical arrangement is new. Parasitic elements originated with Yagi, crossed dipoles from the Brown Turnstile, Gamma matches are standard and phasing lines occur in many different designs. The only new thing that is involved is the combining of all these into a new physical arrangement to achieve diversity reception and transmission.

The basic objective is to develop a forward beam pattern as close as possible to a circle. In the Brown Turnstile both dipoles are mounted in the horizontal plane and produce a horizontal radiation pattern that is almost circular. That pattern, viewed from above, is shown in Fig. 1. The question was whether a Turnstile could be turned on its side and have the horizontal radiation pattern become the frontal aperture of a beam. If this could be done, then such a beam could function equally well in the horizontal and vertical planes, and provide improved performance in oblique planes.

The beam was built and the element lengths and the spacing between elements adjusted for best performance. Two field strength meters were used to make these adjustments, one with a horizontal pickup antenna and the other vertical. In this manner simultaneous readings in both planes were made. After adjusting the beam for maximum forward gain performance, the field strength meters were rotated to test the signal pattern at various angles. The plot of the observations approximated the horizontal pattern of the Turnstile. The slight sag from a circular pattern (marked by the shaded area in Fig. 2) turned out to be a drop of about 5 db.

The design was discussed with a number of amateurs and engineers and the opinion was often expressed that such a configuration would result in a loss of one-half the power in each plane because the available power was being divided between two driven elements. Though tests have not borne out these predictions, I have no idea as yet of why. I'll let you know if further tests shed some light on this.

Feeders

The feeding and phasing system are, as far as I know, original features in the design. All of the Turnstile antennas that I read about used open wire phasing and feeding systems. Using coax cable for this purpose seemed to me to be a simpler system both electrically and mechanically.

The matching and phasing system is shown in Fig. 3. Any transmission line you may have on hand may be used. The chart in Fig. 4 gives

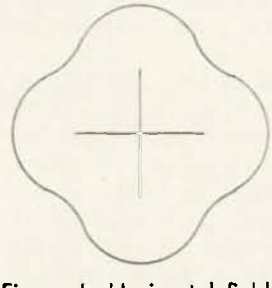

Figure 1: Horizontal field strength pattern of the Turnstile antenna.

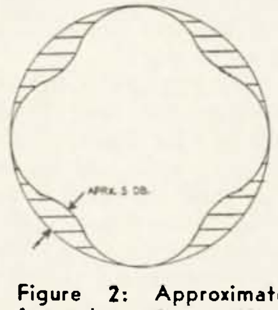

Figure 2: Approximate forward aperture pattern of the beam.

the dimensions for the gamma match for different impedance lines. I used RG58/U because it matched my low-pass filter and RG63 for the phasing line because it made for a shorter gamma match. I did notice, in trying other lines, that the gamma adjustment was not very critical.

Going into the design philosophy just a bit, it will be obvious to those of you with an acquaintance with antenna and feedline theory that Zgb should equal Zpl . . . the feedline impedance should match the antenna. Thus at point X you have the phasing line and feed line, both with fixed impedances, in parallel with the variable impedance of gamma rod A, or Zga. Using the formula for parallel impedances this can be calculated for various types of line and the numbers in Fig. 4 developed.

Only one mechanical problem is involved. The antenna must have the boom high enough above the top guys to the tower (if guyed) so the vertical driven element will not run afoul of the guys when the antenna is rotated.

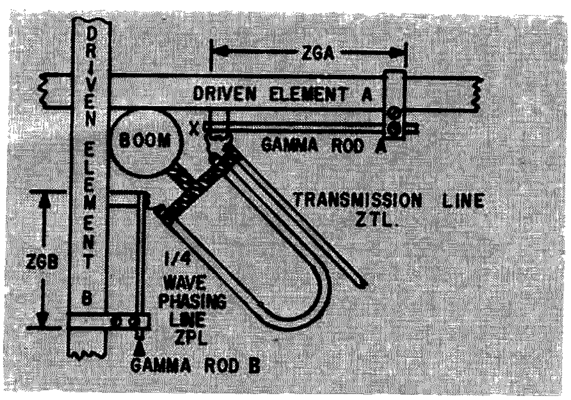

Figure 3: The special matching system.

When assembled to the dimensions shown, without using Gamma or Omega matching condensers, the SWR measured 1.06 to 1. The complications that would arise by trying to get rid of the trivial SWR remaining were deemed not worth the effort. The variance of element length from handbook dimensions resulted from field strength tests that showed the lengths given as providing the best overall performance.

Transmission Line Type	Z_{tl}	Phasing Line Type	Z_{pl} & Z_{gb}	Necessary Z_{ga} to match
RG8/U	52	RG62/U	93	118
		RG63/U	125	89.4
		RG11/U	75	169.5
		RG59/U	73	180.7
RG11/U	75	RG62/U	93	387.5
		RG63/U	125	187.5
RG58/U	53½	RG62/U	93	125.9
		RG63/U	.125	93.5
		RG11/U	75	186.6
		RG59/U	73	200.2
RG59/U	73	RG62/U	93	339.4
		RG63/U	125	175.4

Fig. 4

The beam, which has been in use for one year so far, is constructed as follows:

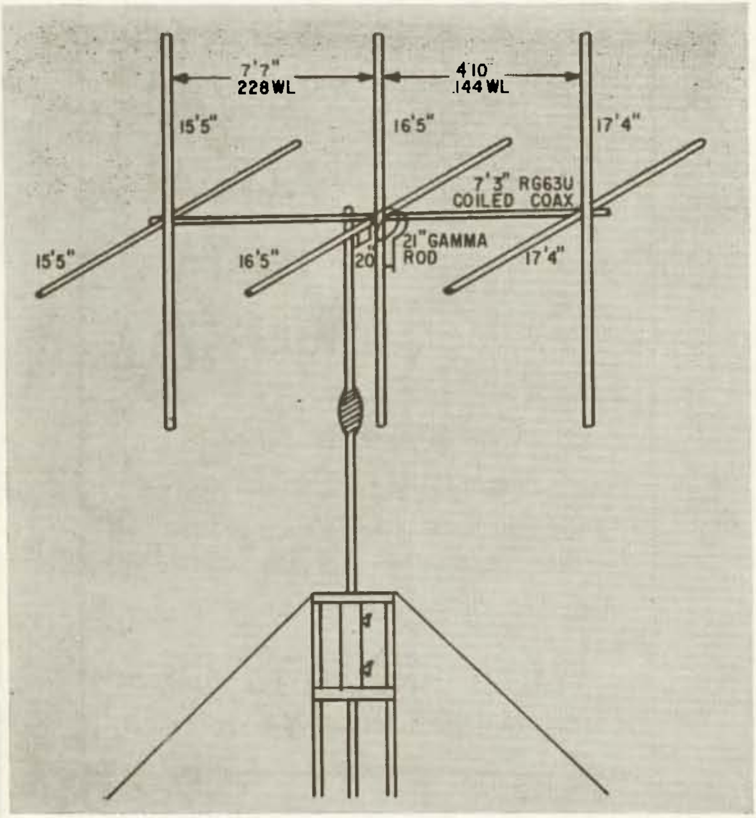

Figure 5

Transmission line connects at junction of horizontal Gamma rod and 1/4 wave phasing line. Mast is attached to the center of gravity of the antenna, which keeps the vertical driven element about 14" from the mast. Spacing between the Gamma rods and driven elements is 4". Ground all coax shield ends together and to mast. Raise antenna above the guy wires so there won't be any interference with the rotation.

Boom: 13 feet long—2 inch outside diameter, aluminum alloy.

Elements: 3 pieces per element—center piece 12 feet long—1¼" diameter, aluminum alloy. Two outer pieces, telescoping into center piece, 6 feet long, 1 inch diameter, aluminum alloy.
For frequency 28.65 mc — element lengths: Reflectors—17' 4"; Driven elements 16' 5"; Directors 15' 5".

Gamma Rods: 5/16" Aluminum tubing, 24" long. Adjustable strap set as follows: Vertical Gamma strap, for 125 ohms—21"; Horizontal strap, for 93 ohms—20".
¼ Wave Phasing Coax—7' 3" of RG63-U.
SWR at design frequency: 1.06:1.

Spacing between Gamma rods and driven elements, 4". At antenna end, all coax shields connected together and to mast.
Balance: Mast is attached to center of gravity of the antenna at the boom. This keeps the vertical driven element about 14" from the mast.

Clearance: Mast is clamped to boom on opposite side from vertical elements which keeps mast out of the immediate plane of the vertical elements.

The beam was compared with a quad two wavelengths away and at the same height. The new beam showed a superiority of 3 to 5 db over the quad. Further experiments with element spacing and length show that 2 to 3 db more is possible by exact measurement and care in adjustment. If the quad is capable of 7 db gain, then this beam, adjusted for maximum performance, should be capable of about 14 db gain!

These specifications, plus the sketch in Figure 5 should provide enough detail for any home builder to copy the beam. . . . K6CT

Silicon Replacements for Tube Rectifiers

There are numerous advantages in the use of silicon rectifiers over tube rectifiers. Unfortunately, some equipment was built before silicon rectifiers were available at prices that compared with vacuum tubes. There are applications where tubes are superior, but these are usually in circuits requiring a high PIV. In such circuits, the high cost of silicons when the number required to make up the PIV required, or the use of special silicons, make it more practical to use tubes. Where the voltages are lower, the silicons are superior to vacuum tubes because of their smaller size, increased efficiency, cooler operation and the fact that they don't require heater voltage. While on the topic of heater requirements,

it is usually overlooked that the heaters or filaments of rectifiers require tremendous (comparatively) amounts of filament power. An example of this is the 5U4, one of the most common rectifiers used, which has a heater input of 15 watts; the 5Y3 which requires 10 watts; or the 5AU4 which requires 22½ watts. Compared to amplifier tubes, the power used is tremendous. A small tube like the 6C4 requires less than a watt while the larger power tubes like the 807s use about 5½ watts of heater power. In some circuits, the heater power of the rectifier is larger than the entire plate power used. To me, waste like that seems ridiculous, as eliminating the heater power of the rectifier would almost halve the AC power required. Another disadvantage of vacuum tubes is the large amounts of heat that they generate. In compact equipment, it makes the area around the power supply extremely hot which leads to failure of parts prematurely as well as the requirement for increased ventilation. About half of the failures in filter condensers which are placed near the rest of the power supply can be traced to excess heat from the rectifier tubes. The problem is multiplied by the use of a can type filter placed almost next to the rectifier tube. Silicons are also more efficient since they have a lower voltage drop across them.

In some equipment, the change to silicons is simple as all that is required is to solder two of them in place and add a protective resistor. In other equipment, the rectifier socket is almost inaccessible. The obvious solution is a plug-in assembly to replace the tube rectifier. This can be made by removing the base from an old rectifier tube, and soldering the rectifiers to the correct pins in the base, along with the protective resistor. It should then be possible to plug it into any equipment which uses the tubes, as long as the ratings on the rectifiers aren't exceeded.

The rating that usually has to be watched is the PIV. When a rectifier is used in a full-wave circuit, the PIV is the *full* voltage between the ends of the plate winding X 1.41 plus a safety factor. For example, if a full wave power supply is to deliver 100 volts output, the PIV of the rectifiers should be 200 X 1.41 or 282 volts. With a safety factor, the PIV of the rectifiers should be 300 to 350 volts. When figuring output voltage allow for the drops across the rectifiers, protective resistors, transformers, chokes, etc. The protective resistor is necessary to protect the rectifiers from surges of current when the unit is first turned on. A discharge filter will appear as a dead short to the rectifier and can draw several amps of current until it is charged, especially if voltage is applied on the voltage peak of the cycle. The resistor limits this current to a safe value.

The uses for this plug-in are almost limitless, and it is usually worth while to have several around. . . .WA2INM

VFO Circuits

Staff

LAST month, we explored the field of crystal oscillators in some detail, and promised you a similar study of VFO circuits in a later article. This is it.

Almost every ham who graduates from the Novice license looks forward to the day when he is allowed to use a VFO to control the frequency of his transmitter, rather than being rockbound at a few selected spots within the bands.

But after a little experience with the VFO, the ham who is a perfectionist rapidly learns that the word "variable" in the name "variable frequency oscillator" frequently means exactly what it says: unpredictable, movable within wide limits, not stably fixed. In other words, there's a world of difference between the rock-like frequency stability of a crystal oscillator and the performance of many VFOs.

Much of the difference is inherent in the physical distinctions between the frequency-controlling elements, since it's hardly possible to get an LC circuit's Q up to 25,000, while this figure of quality factor is common in quartz crystals. But the popularity of side-band and VHF interest have combined to focus attention on high-stability oscillators, and the result is that—on the lower bands, at least—it's possible to build a VFO whose performance can't be distinguished from that of a crystal oscillator.

One key point of VFO technology can't be overemphasized, though you've undoubtedly heard it many times. That is the fact that frequency stability is determined more by mechanical considerations than by the individual circuits involved. While it's true that some circuits have inherently greater stability than others, even the least stable basic circuit can give excellent results if its construction is mechanically sound. On the other hand, no matter how stable the circuit *should* be, it will show drastic instability if components are free to move, subjected to extreme temperature changes, or if construction is otherwise sloppy.

Another point less frequently emphasized is that almost any oscillator is stable when it's operating without a load. The only way to check out a VFO and get accurate results is to test it in action, connected to the transmitter just as it will be when in use. Naturally, all such tests should be run into a dummy load, not into the antenna, to keep in good favor with your fellow hams and with the FCC.

From here on out, we're going to assume that good construction practice has been followed when comparing performance of various VFO circuits. A few tips on mechanically solid VFO construction are gathered at the end of the article.

Before we delve into the intricacies of individual VFO circuits, let's look at the basics of vacuum tube oscillators.

In general, oscillators can be divided into either of two major pairs of classifications. One grouping breaks them into relaxation and sinusoidal oscillators, but that's useless for us because we're only interested in sinusoidal oscillators. Square waves, sawteeth, pulse trains, and the like have their places, but not as transmitter VFOs. So we'll use the other pair of classifications: feedback oscillators, and negative-resistance types.

One interpretation lumps these all into one group, on the basis that the feedback provided by a tube circuit introduces effective negative resistance. However, it's easier to understand circuit action by considering them as separate groupings.

Only three types of negative-resistance oscillators are in anything like general use these days: the transitron, the point-contact transistor circuit, and the tunnel-diode circuits. Of these, we'll look only at the transitron circuit (semiconductor circuits are of sufficient importance to warrant another article all to themselves) and the discussion of negative-resistance oscillators will be deferred until we reach that circuit.

All the other oscillators in use are of the feedback type, in which a portion of an amplifier's output is fed back to the input. When just enough signal is fed back to provide a steady input, the closed-loop system formed is self-sustaining and requires no external signal to keep going. The first major differences in oscillator circuits evolved from different methods of obtaining and applying the feedback.

A more complete analysis of the general feedback oscillator shows that it consists of four separate and distinct functions. These are (1) an amplifier, (2) a limiter to maintain feedback value at the proper point, (3) a resonator to determine frequency, and (4) a load. In practice, some of these functions are combined in a single circuit element. For instance, in most VFOs the tube acts as both amplifier and limiter, and the tank circuit may

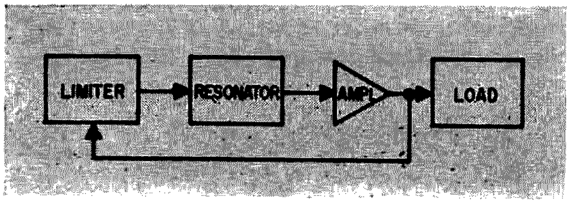

Fig. 1

serve as both resonator and load.

A block diagram of this breakdown is shown in Fig. 1. To examine it more closely, let's start with the amplifier.

The amplifier is actually the heart of the oscillator, for without it, the circuit could not function. However, it is just a conventional amplifier circuit, regardless of the overall circuit complications. Only two design choices are possible so far as the amplifier is concerned; it may be operated in Class A for maximum frequency stability due to minimum harmonic output, or it may be operated Class C for simplicity of the circuit.

Most common VFO circuits use the amplifier in Class C so that the limiter may be combined with it (more about this a little later) and accept the loss in frequency stability.

The limiter's purpose is to keep the amplifier's input signal constant. If input signal were not kept constant, the output would increase with time until it reached infinity—which is obviously an impossible situation. If no limiter is provided as such in a circuit, then the physical properties of tubes themselves will provide one, because at some point you discover that the tube is putting out all it can, and increased input causes no change in output.

Most VFOs do it in just this way, too. The tube is biased well below cutoff by a grid leak resistor, and acts as a Class C amplifier. Large pulses of feedback drive the tube to saturation, producing large pulses of plate current, and it's up to the resonator to smooth these pulses into sine waves.

Addition of a limiter circuit and the accompanying switch of the amplifier from Class C to Class A can improve stability of the oscillator, but it's not usually worth trying until all other improvement methods have been exhausted.

The most critical component of the oscillator is the resonator, because it determines the frequency. In a crystal oscillator, the crystal itself is the resonator. In microwave work, the resonator is frequently a cavity in the tube itself. But in most ham VFOs, the resonator is composed of an LC circuit which resonates at the desired frequency.

The ideal resonator would discriminate sharply between currents at its resonant frequency and all other currents, passing one and rejecting the other. Such a resonator has not been and probably never will be built, because

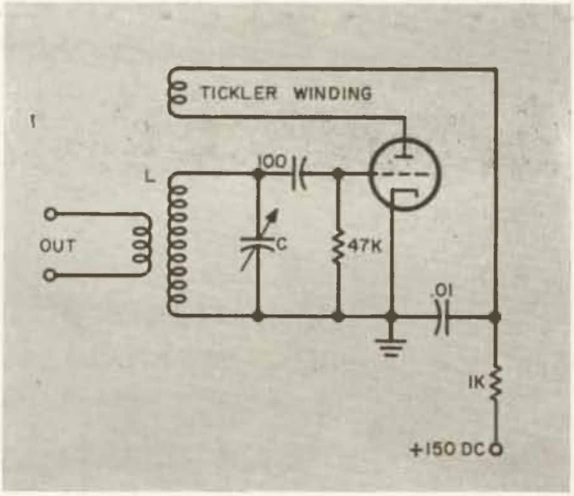

Fig. 2

it's a physical impossibility at the current state of the art.

Characteristics of the best available resonators include these: extremely high Q; suitable impedance level for the circuits; resonant frequency which is not affected by time, temperature, or other uncontrollable variables; and lack of undesired resonances.

Since everything connected to the resonator becomes, in effect, part of the resonator also, we must keep the resonator as isolated as possible from the rest of the circuit. This means that coupling between the resonator and the other components must be extremely light.

Little needs to be said about the load except that it should be completely isolated from the resonator. For good frequency stability, it's best to run the oscillator with extremely light loading, separate it from the power amplifiers with an isolating buffer amplifier, and build up the power in later stages.

With the sole exception of the Transitron circuit which we mentioned earlier, all the VFO circuits described here operate in the manner we've just described. Individual differences in the detailed operation of the various circuits, though, make some better than others for specific uses.

For each circuit, we'll go into the detailed theory of operation, identify the elements which perform the four basic functions, tag critical components, and finally, we'll compare the circuits on the basis of frequency stability, efficiency, and power output as well as pointing out any unique advantages or disadvantages.

With the great variety of VFO circuits available, it's difficult to classify them in any meaningful pattern. One way to do it is merely to take them in historical precedence—and that's what we did. One caution—frequently a single circuit is known by several names, and the name under which it's listed here may not be the one you're most familiar with. However, we have attempted to include all VFO circuits available in the literature as well as a few which aren't too widely known. If your favorite isn't included, let us know — the chances are great that it's one of the relative unknowns which the rest of us would like to hear about.

The progenitor of all vacuum-tube oscillator circuits was that invented in 1914 by young Edwin Howard Armstrong, which bears his name. It's listed here for historical interest only; later circuits achieve better performance with fewer parts.

In the Armstrong circuit (Fig. 2), the output of the amplifier tube is inductively coupled to the grid tank by the feedback winding. The grid tank acts as resonator, and limiting is achieved by saturation of the amplifier. The load is usually coupled to the resonator by a separate winding, but may be placed in series with the feedback winding if desired.

Since feedback is determined only by the coupling between "tickler" and grid coils, this oscillator gives strong output with almost any tube regardless of gain. However, its stability is not so great as later circuits because grid, plate, and load circuits are all coupled closely to the resonator. Its only widespread use now is as the local oscillator in many inexpensive BC receivers, where dependability is the chief desired characteristic.

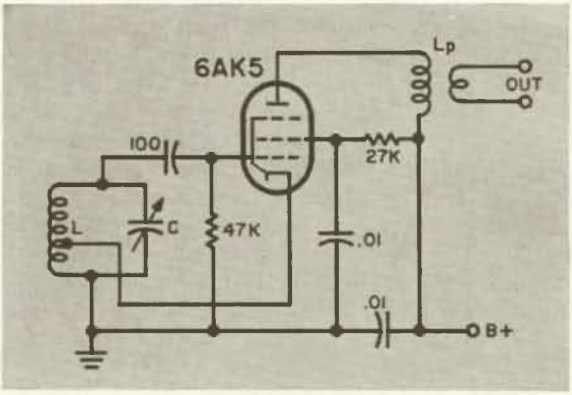

Fig. 3

By joining the "tickler" and grid coils into one winding, then moving the rf ground point from the cathode to the plate, Hartley developed the oscillator (Fig. 3) which bears his name. The tube continues to serve the dual purpose of amplifier and limiter, and the grid tank is still the resonator, but now the load may be taken by electron coupling if we use the screen of a pentode as the plate of the oscillator as shown in the schematic. This isolates the load from the resonator to a much greater degree, thus improving frequency stability.

The Hartley oscillator is widely used as the local oscillator in communications receivers, and for many years was the standard VFO circuit for hams. More recent circuits have tended to put it in the shade for transmitter use, but with proper design a Hartley can still hold its own. A little farther on we'll look at

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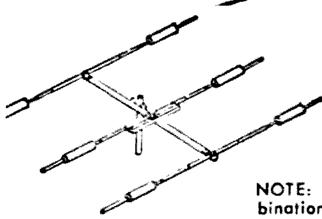

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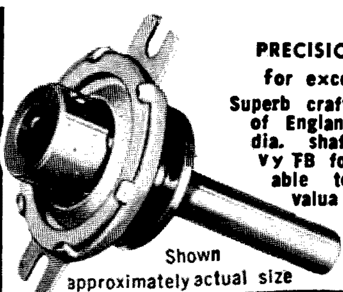

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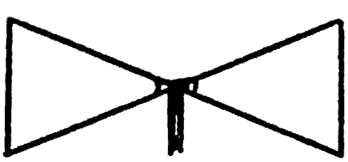

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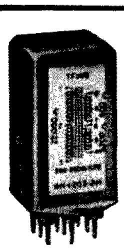

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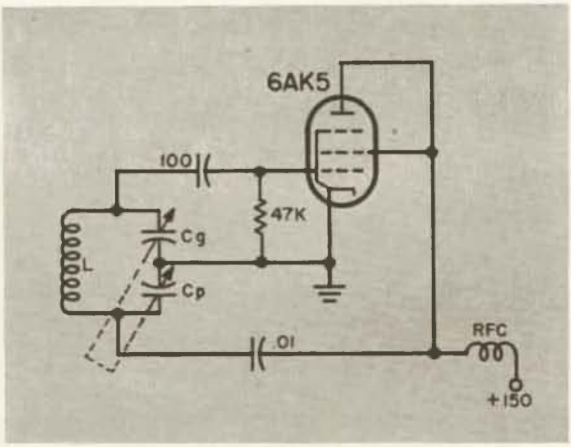

Fig. 4

some updated versions of the older circuits.

The greatest weakness of the Hartley circuit is that the load current must flow through a part of the resonator to return from the cathode to ground. This introduces some coupling between load and resonator despite the electron coupling, and also degrades frequency stability if harmonics are present (and they always are).

Even if harmonics are at very low level, the dc flow through part of the tank coil causes local heating of the wire, with consequent physical expansion, change of inductance, and change of frequency during operation (described as short-term drift). The only way to avoid this drawback with the Hartley circuit is to move the ground to the cathode, which then eliminates the possibility of efficient electron coupling to the load.

This difficulty is avoided in the Colpitts oscillator (Fig. 4), a close relative of the Hartley circuit. In the Colpitts, feedback is achieved by current flow through a part of the resonator capacitance (Cp). Electrically, there is no difference in the circuits, since the "tapped" capacitor made up of Cp and Cg in series is equivalent to the tapped coil of the Hartley. Mechanically, though, the difference is great, since dc flow through any part of the resonator is eliminated.

In its basic form as shown in Fig. 4, the Colpitts is hardly used any more except at UHF. In fact, one authority (Pullen) has concluded that it's impossible to design a good Colpitts oscillator for use below 10 mc. However, modified versions are now finding wide acceptance, and we'll come back to it later.

Considerably different from these oscillators is the next circuit, the Franklin (Fig. 5). Developed many years ago but almost neglected until recently, the Franklin oscillator has been claimed by some to be equal to many quartz crystal circuits in frequency stability.

Despite its unusual appearance, the Franklin operates in the same general manner as all other feedback oscillators. The amplifier of the Franklin is a two-stage affair instead of just one; both tubes are used in a closed-loop RC circuit. Limiting is achieved by saturation of the amplifiers, and the resonator is a conventional LC circuit coupled loosely to the circuit between the two stages.

In the absence of the resonator, the circuit would operate as a multivibrator, generating square waves in the audio range. However, the resonator offers a low-impedance path to ground for all signals except those at its resonant frequency; for those signals, it is a high impedance.

This means that the amplifier is loaded down at all frequencies except that to which the resonator is tuned, but has a high-impedance load at that single frequency. Therefore, oscillation is confined to the frequency of the resonator.

The secret of the circuit's extreme stability is that the resonator is almost completely isolated from everything else. It is coupled to the amplifier loop only by the small capacitors, which effectively keep all external influences away from the tank. The load is connected on the other side of the loop for additional isolation.

The advantage of the Franklin oscillator is, of course, its stability. Its disadvantage is extremely low output, measured in tenths of a volt and requiring amplification for any use at all, even in a receiver.

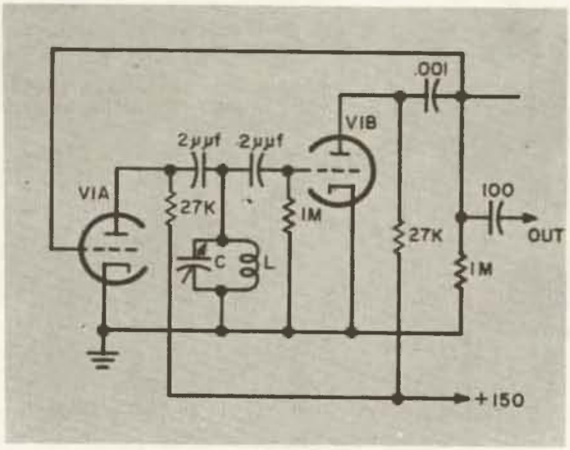

Fig. 5 VI-12AT7

Offering even higher stability at low frequencies is the Meacham bridge oscillator, shown in Fig. 6. This circuit, developed at the National Bureau of Standards and used also by Bell Telephone Labs and the British Government Post Office for frequency standards (but with a crystal instead of an adjustable tank), can achieve stability on the order of one part in 10^9. That's one cycle variation at 1,000 mc! As a VFO, naturally, stability won't be that good, but by virtue of its special features of operation it will give much higher stability than any other circuit with the same resonator.

The Meacham bridge, like the Franklin, is a two-stage circuit. Both stages together make

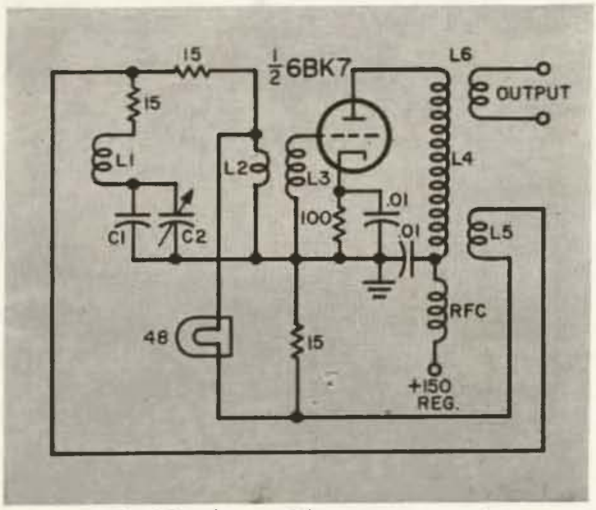

Figure 6. Meacham Bridge VFO, Experimental Circuit Diagram.

C1—35 mmf double-spaced variable
C2—100 mmf air trimmer
L1—17.5 michrhenry Q = 200 (Miller 43A155CBI or equivalent)
L2—5 turns #20 bifilar-wound with LO3
L3—335 turns #24 on small toriod form
L4—260 turns #24 on small toriod form
L5—10 turns #20 bifilar wound at B+ end of L4
L6—30 turns #24 bifilar wound at plate end of L4
NOTE—If circuit refuses to oscillate reverse connections to L5. Effective Q of circuit should be greater than 15,000.

up the amplifier, and the resonator is located in the feedback loop. However, unlike all the other circuits we've examined, the Meacham uses a separate limiter. This allows the amplifier to operate in Class A, providing exceptional stability and purity of the frequency in itself.

The special feature of the Meacham circuit, though, is the manner in which the resonator is connected. As you can see from the schematic, feedback is achieved through a bridge circuit. The resonator is located in one leg of this bridge. When the bridge is balanced, no feedback can get through and the circuit cannot operate. When the bridge is slightly unbalanced, a small amount of feedback gets through.

The circuit is designed to operate almost at balance. The lamp, also connected in the bridge, is the limiter. Its resistance varies with the voltage across it, and by proper choice of the values in the resistance legs of the bridge the circuit can be made to balance in the most sensitive portion of the lamp's variable-resistance range.

Since three legs of the bridge are pure resistances, the bridge can be balanced only if the resonator acts as a pure resistance also. This condition is achieved only at series or parallel resonance. Since values of the other three legs are all low, the bridge will balance only at series resonance.

However, we said earlier that, at balance, no feedback gets through and the circuit stops working. Here's where the interplay between the limiter and the resonator starts to work. If the circuit stops, there is no output. With

no output, no voltage is applied to the lamp. With no voltage, resistance drops from the balance value and the bridge is unbalanced. With the bridge unbalanced, feedback is re-established and oscillation resumes. It builds up until the bridge is balanced. With the bridge balanced . . . and off we go again.

That's the picture theoretically. In practice, the thermal time constant of the lamp filament is long enough that operation settles down within a couple of rf cycles to the just-off-balance point at which the circuit is designed to operate.

This is all very well, but what does it have to do with stability? Let's look at the bridge again. If frequency tends to shift slightly from the series-resonant point, the resonator is no longer a pure resistance. With reactance present, the bridge is unbalanced. More feedback gets through, and oscillator output increases. This output is shifted in phase by the pass through the resonator, and the phase shift is in such a direction as to tend to drive the frequency instantaneously back towards the resonance point. This continues until the output is back at the resonant frequency and the bridge is back almost in balance.

You can see that the bridge connection of the resonator acts to multiply its phase-shifting abilities, which is the same thing as saying to multiply its Q. The numerical amount of this Q-multiplication is equal to the reciprocal of the operating unbalance figure; with the circuit shown, it's about 200. This will increase the normal Q-of-100 value found in a well-constructed VFO tank circuit to 20,000 — a figure comparable to that of a crystal!

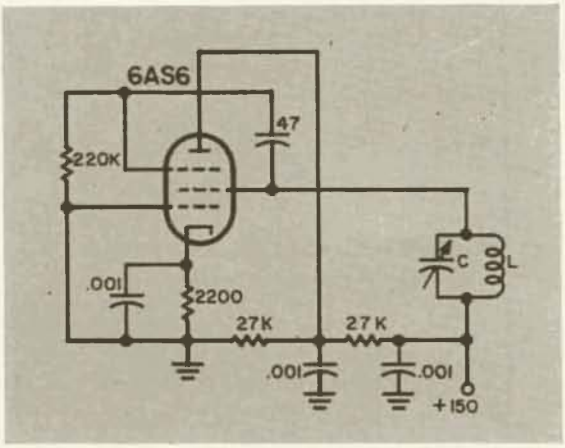

Fig. 7

The Meacham circuit is best suited to use at frequencies below 500 kc, because stray feedback becomes a problem at higher frequencies and the entire operation of the circuit depends upon critical balance of the bridge, which can be upset by stray feedback. However, no tests have been run to determine the upper frequency limit; the circuit shown in Fig. 6 is theoretical and untested but should work properly with parts values as shown.

The next circuit we'll examine is the Transitron, so named because it makes use of the transit time of electrons between screen and suppressor grids in a pentode tube to provide an effective negative resistance. The circuit is shown in Fig. 7.

In most pentode tubes, if the screen is operated at a voltage higher than the plate voltage you'll find a region where Ohm's Law seems to work in reverse. That is, as plate voltage goes up plate current comes down. Mathematically, this is the same thing as a negative resistance.

The reason for the strange behavior is simple. In the region below the knee of the characteristic curve, screen current increases with an increase of either plate voltage or screen voltage. With fixed grid bias, the total current leaving the cathode is also fixed. Thus, when an increase in plate voltage causes an increase in screen current, the only place from which the extra screen current can come is by a diversion of electrons which would otherwise have gone to the plate.

We said that mathematically this is the same thing as a negative resistance. Strangely, mathematics holds pretty true in most areas of electronics, and this is no exception.

Jumping away from the main subject for a moment, you'll recall that the only thing that keeps an LC tank circuit from oscillating indefinitely is the internal resistance of the circuit itself, which eventually damps out the oscillation by dissipating the energy.

Now, from a mathematical point of view, the internal resistance of the tank can be eliminated by adding a suitable amount of negative resistance to make the total resistance zero.

Physically, we do this in the transitron oscillator by connecting the coil between screen grid and plate. This couples the negative resistance of the plate circuit into the tank, and oscillation results.

The Transitron and other two-terminal oscillators have several distinct advantanges over feedback circuits: Since the resonators require no feedback provisions, changing resonators becomes an easy job. Bandswitching is convenient in a VFO, and as a bench test oscillator only two leads are necessary. In addition, these circuits will operate from the audio range up to several hundred megacycles without change, making them especially versatile as bench test units.

Authorities differ concerning the comparative stability of the Transitron oscillator. Some claim it has frequency stability classed with the best feedback circuits, while others denounce it as unstable and unreliable. It appears that the circuit's operation is dependent on many factors, not all of which are as fully understood as they might be, and all of which influence stability.

Another popular two-terminal circuit has

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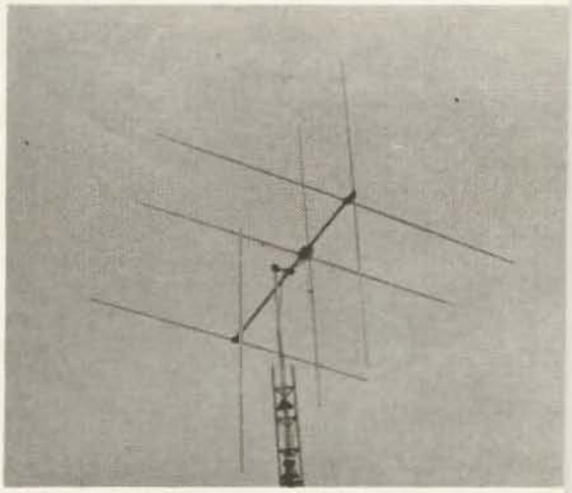

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10 METER BAND

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B-10-6	K6CT Polarized Diversity Beam, 6 element. 1¼" O.D. Center Sections; 1" O.D. & ¾" O.D. adjustable end sections. Boom: 2" O.D. 15' long. .125 .19 Spacing Forward gain 12 D.B. Front/Back ratio; 44 D.B.	$70.00	32 lbs.

15 METER BAND

Model	Specifications	Amateur Net	Weight
B-15-6	K6CT Polarized Diversity Beam, 6 element. 1¼" O.D. Center Sections; 1" O.D. & ¾" O.D. adjustable end sections. Boom: 2" O.D. 15' long. .125 .19 Spacing. Forward gain 12 D.B. Front/Back ratio; 44 D.B.	$90.00	38 lbs.

20 METER BAND

Model	Specifications	Amateur Net	Weight
B-20-6	K6CT Polarized Diversity Beam, 6 element. 1¼" O.D. Center Sections; 1" O.D. & ¾" O.D. adjustable end sections. Boom: 2" O.D. 24' long. .125 .19 Spacing. Forward gain 12 D.B. Front/Back ratio; 44 D.B.	$114.50	44 lbs.

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been published in at least three different versions. They're shown as circuits A, B, and C in Fig. 8. While this circuit is definitely a two-terminal affair and so might be classed as a negative-resistance oscillator, it can also be analyzed as a feedback circuit. Feedback is obtained through C1, and is effective at all frequencies. However, the circuit provides gain only at the parallel-resonant frequency of the tank circuit or resonator, and thus can oscillate only at this one frequency.

The advantages and disadvantages of this circuit are practically the same as those of the Transitron. However, the twin-triode oscillator has fewer parts which might prove critical.

Getting back to the more-conventional oscillator circuits, we're just now getting to the one which for the past 12 years has been almost the standard circuit for ham-use VFOs —so much so that many newcomers may not be aware that any other circuit exists. This is the Clapp oscillator, first announced in 1948.

Some authorities have "proved" that the Clapp circuit has inherently greater frequency stability than any other design, while others of equal eminence have "disproved" this assertion.

Actually, the Clapp circuit does provide greater stability *with respect to tube variations* than any other circuit, if we confine our analysis to designs using practical component values. However, recent developments in tubes have brought other circuits to almost-equal stability at less expenditure of time in construction.

The Clapp oscillator, shown in Fig. 9, differs from most other circuits in that its resonator is series- rather than parallel-tuned. Use of series tuning enables high values of parallel capacitance to be employed while still retaining wide tuning range. However, it also makes mandatory the use of a large, extra-high-Q coil, which in turn raises problems of mechanical stability.

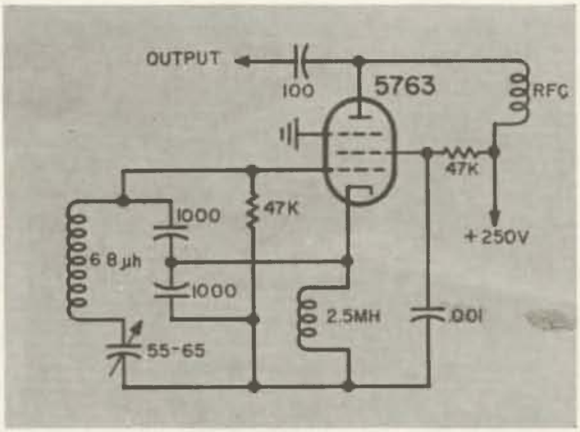

Fig. 9

Actual operation of the Clapp circuit is similar to the Colpitts, and the only electrical differences are the method of tuning and the large-value parallel capacitors.

The frequency stability is directly due to the large-valued parallel capacitors, which effectively swamp any changes of tube characteristics. This stability, incidentally, is *only* with respect to tube variations. Mechanical flaws of feedback to the VFO circuit from later stages can still play hob with your signal. In practice, the tank circuit of a Clapp oscillator is usually placed in a completely shielded compartment and tied down solidly to prevent any motion of the coil or other components.

The attention given the Clapp circuit has also been focused on its ancestor, the Colpitts, with the result that a number of Colpitts oscillators producing equivalent preformance have been described.

One of the earliest was the Vackar (1955), shown in Fig. 10. The Vackar oscillator shows its similarity to the Clapp in the high value of parallel capacitors and the isolation from the tank to the grid achieved by capacitative voltage-divider action. However, the feedback is taken from plate to grid rather than

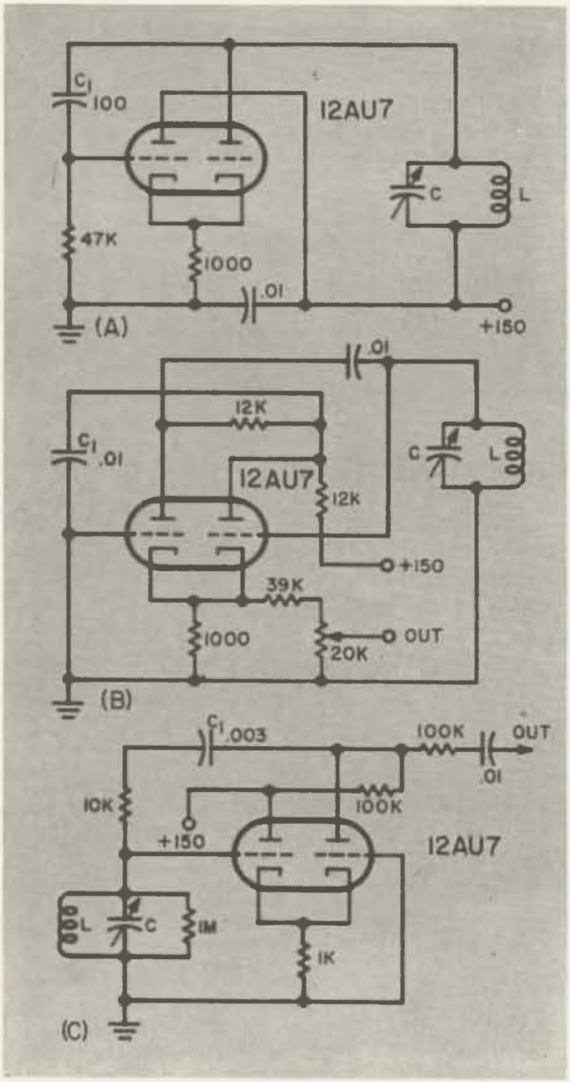

Fig. 8

from the cathode, the resonator is parallel- rather than series-tuned, and both the cathode and one side of the tuning capacitor are grounded.

The only circuit in print which employs the Vackar oscillator shows a drift figure of only 3⅓ cycles per minute under best conditions. Under these conditions, a SSB signal wouldn't drift far enough to sound unnatural in 15 minutes.

Another version was described by Robert J. Ropes in early 1957. He called it the "Class A Colpitts." This design (Fig. 11) doesn't use quite so much capacity to isolate the tube, but makes interesting use of high-value cathode resistors to maintain grid bias high enough to prevent any grid current flow. No provision for limiting is made in the circuit; it appears to be automatic as a result of the high cathode bias.

Ropes claims that the circuit would hover "within a few cycles per second" of WWV for "hours at a time," but does not mention whether this test was made under load. Apparently this circuit has not been employed in any ham transmitter design which has been published; however, it appears attractive as a simple and reliable oscillator.

The most persuasive argument for abandonment of the Clapp circuit and a return to the High-C Colpitts design was made by W. B. Bernard, ex-W4ELZ, in late 1957. He pointed out the disadvantages of the series-tuned circuit and the advantages of a similar parallel-tuned arrangement.

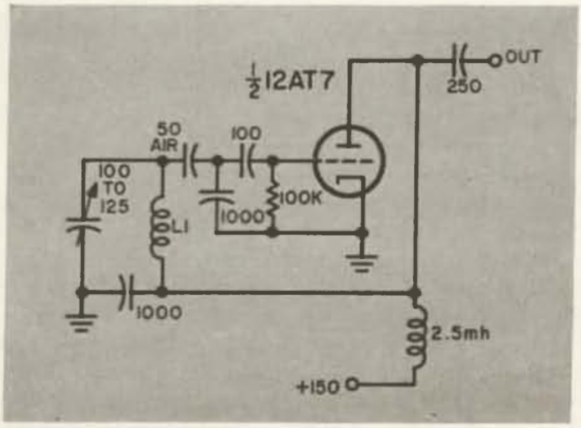

Fig. 10

Bernard's version of the High-C Colpitts utilized a grounded-cathode oscillator tube with separate buffer amplifier. He also listed a series of design equations for calculating your own High-C Colpitts to fit your individual needs (see bibliography). The circuit shown in Fig. 12 is based on his design procedure but has been modified from his original circuit to take advantage of more recent tubes which have high gm and allow proportionately increased stability.

Before leaving the Colpitts circuit and its

variations, mention must be made of General Electric's "Lighthouse Larry," who helped pioneer the rebirth of the High-C Colpitts by using it as the VFO in his popular 150-watt single-band contest transmitter. Since the GE circuit is similar to the three discussed here, we haven't shown it separately.

We said earlier that mechanical stability is a more important characteristic of a VFO than any of the electronic parameters of the individual circuit. The only way to achieve this mechanical stability is through careful attention to the geometry of not only the electronic components in the circuit, but the mechanical items such as the chassis, cabinet, and capacitor-driving mechanism as well. Many a good VFO circuit has been built on a standard aluminum chassis, and the builder has been left wondering why he can't eliminate that last trace of frequency wobble. Had he taken a tip from the people who build hi-fi loudspeaker enclosures, and used *heavy* material for the supporting structure, he probably would have discovered he had a rock-stable oscillator!

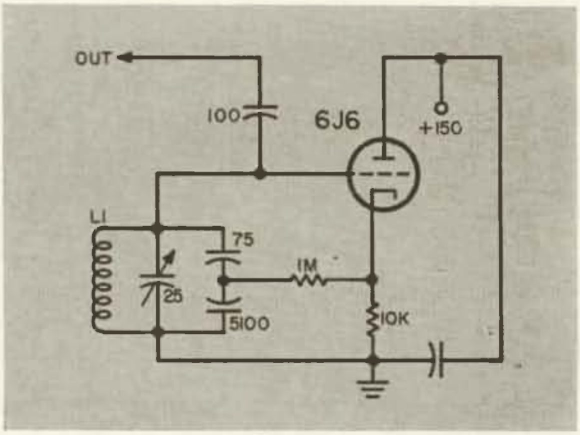

Fig. 11

A good VFO chassis can be obtained by using a chunk of ⅛-inch thick aluminum carved from a standard relay-rack panel, bending it over only at the front edge to attach to the cabinet, and mounting all components firmly in place (using tie points and standoff insulators liberally). An even better chassis can be put together with medium-hard 1/16-inch stock bent at the front and the two sides, and bolted (not soldered or welded—heat introduces stresses) at the front joints to achieve a sort of triangular bracing of the structure.

In either event, the cabinet should be only for decorative and dust-catching purposes. An inner shield (*firmly* attached to the solid chassis) should isolate the circuitry from any electrostatic coupling to the cabinet. Dial drive mechanisms should be precise in their action, and should *float* so far as the cabinet is concerned, being mounted firmly to the chassis only.

Incidentally, heat is one of the biggest enemies of VFO stability. The perforated Reynolds do-it-yourself aluminum stock provides a perfect answer to the heat problem. Simply make the shielding from this perforated stock, and your ventilation problems are over. Cooling fans are *not* recommended; their vibration, however small, will put a wobble on your signal.

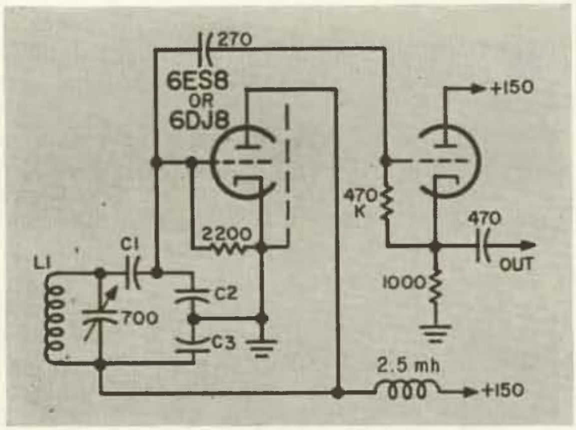

Fig. 12

Heat can be avoided in an electrical way, too. A vacuum tube produces heat in two ways. First, of course, is the heater, and you can't do too much about that. One answer is to go to small battery tubes such as the 1R5 triode-connected or the 3S4, and this approach has been used with excellent results by W2ZGU. The second way in which heat is produced is by plate dissipation. Less than half the power fed to an oscillator tube shows up in the output; the rest is converted to heat and radiated from the plate. Since little power is needed from the VFO, you don't have to feed much to the tube. Cutting tube input down to half will reduce the output by half, but it will also reduce the heat by half at the same time. The output can be restored in later stages. The frequency stability can't. The circuits shown here will work at plate voltages as low as 30 volts—try them and see.

One of the biggest mechanical bugaboos in construction of a high-accuracy VFO is in the tuning mechanism. Using the conventional fixed-coil-variable-capacitor combination, you have to lay out much cash to get good accuracy (such as the $30 National HRO-type unit or the $80 Cardwell precision capacitor). However, you can swipe a trick from the Collins people and build a permeability-tuned circuit with accuracy comparable to the best, for almost peanuts. One such circuit is described by W5HZB (see references) and others are also in print.

The difference, of course, is that the permeability-tuned circuit uses a variable-inductance coil rather than a variable capacitor. By proper choice of coil winding pitch, the calibration can be made completely linear over any desired range, or can be spread in places and compressed elsewhere as desired. Since

coil slugs normally move only about 1/32-inch per revolution of the shaft, the tuning rate can be as slow as you like.

All the way through this article, we've been considering the VFO strictly as a transmitter component. Naturally, it is also used in receivers—but there it's called the local oscillator. If you're looking for increased stability in your receiver, or considering homebrewing a complete hearing aid, these circuits can give you the same stability in reception that you seek in the transmitter.

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Obtaining that License for your DX-Pedition

Gus Browning W4BPD
144 Broughton S.W.
Orangeburg, South Carolina

HAVING recently returned from a successful DX-Pedition, I have been asked a number of times, "Gus, how did you get permission to operate from all those places?" Each place I visited required a slightly different approach, and I can give only a general view of the procedure.

The first and probably the most important step is realizing that you are no better than anyone else. Make it a point to have people think of you as a friend when you leave them. Keep a big smile on your face, be a good hand shaker and back slapper.

Andorra was the only country that refused to give me a permit and I feel if I had more time I could have gotten a permit there. Rule two is "Try to have plenty of time when you reach the rare spots so you will have time to work on the proper official." I did not attempt to obtain permission to work from the more well known spots in Europe, as I had no desire to operate from them.

The usual procedure in securing my permits went like this: When I arrived in my prospective operating area, I left my KWM-2 at the airport customs office, telling them I would return for it. I would then find the proper official and, putting a big smile on my face, walk into his office. The conversation was usually, "Hello Mr. ...., my name is Gus Browning, I am an American, and I have come all the way from America to visit your wonderful country. I want to meet as many of your wonderful people as I can while I am here. I am certain that those I have met are the finest people in the world and I want to congratulate you on having such fine people and such a fine country. People here are just like my friends back home. They have made me feel really welcome here. I hope some day to have some of them come to America so that I can have a chance to return their hospitality. Maybe you can someday come to America too, I would like to show you around and let you meet my friends. We seem to have so much in common I am sure you would feel right at home. I want to give you my home address so you can look me up when you come over. Be sure to drop me a letter now and then to let me know how you and your family are getting along. This is just a social visit Mr. .... Before I leave let me order a cup of coffee for us to drink. (By this time we usually have ordered coffee and are drinking it.) When I leave he has asked me to return and visit him again and possibly I have an invitation to visit his home.

When you return you follow the same line and, as an afterthought, "Mr. ...., I wonder if you will do me a *small* favor? He will say certainly, if it's within his power. Explain that maybe someday you can do him a favor in America. Then say "I have a small radio outfit at your customs station (I never did use the phrase "radio receiving/transmitting sta-

tion") and the entire purpose of the trip is for talking to as many of my friends all over the world as possible. I am sure my low power station will not put out a strong enough signal to be heard back in America, but I would like to at least give it a trial while I am here. It will only be for a few days and would you please give me a temporary permit to just test it." All you want is a temporary *permit*, don't mention the word license. The permits are usually for thirty days. "I want to come to your country in a few years and bring my wife with me. If, however, you cannot give me a permit I will have to leave tomorrow, since this is a radio testing holiday. I would like to stay longer to get to know both you and your country better, but the entire purpose of the trip will have been defeated and I will have to go to a neighboring country to test it out." If you have been diplomatic he cannot refuse the permit. After you have the permit you are ready to get the KWM-2 through customs. At most of my stops the official who gave me the permit wrote a note to customs requesting them to let me have the rig, saying that he had given me a permit and it was all right to let the KWM-2 into the country. One took me to customs in his own car to help me get the rig.

If it's possible to make some official contacts with the proper man in some of these countries before you arrive it will help a lot. A letter of introduction will go a long way to open the door for you. A ham living there will usually do all he can to help. (M1B helped in San Marino, VQ3HV in Zanzibar, Rundy in the MP4 spots, Wayne Green, by knowing the French consulate in New York City, for Djibouti).

My final word is to fly by the seat of your pants, be everybody's friend, keep smiling, and always ask for "just a temporary permit" for your small low powered outfit.

W4ECI and I are now in the process of planning another DXpedition the early part of next year, either Jan. or Feb., this one lasting about one year and taking me to (I hope) 100 countries, some of them easy to work and many of them brand new Virgin spots.

A great deal of details to attend to, but I am getting lined up with some fine connections in many of them, and expect more connections before I leave.

W4ECI will be the man back home attending to QSL chores, etc. This time at least 50% will be SSB. Will also use 40 and 80 this time, so gang get your low frequency antennas in good shape. I will keep the DX chasers busy for a year the way it looks at this time.

For our SPECIAL DXCC Certificate DON'T MISS ME IN ANY SPOT, even if its only a DL, etc. This means you will have to be on the ball about once each week . . . no vacation this coming year for those Certificate Chasers.

Gang remember I only want very short QSO's. . . . W4BPD

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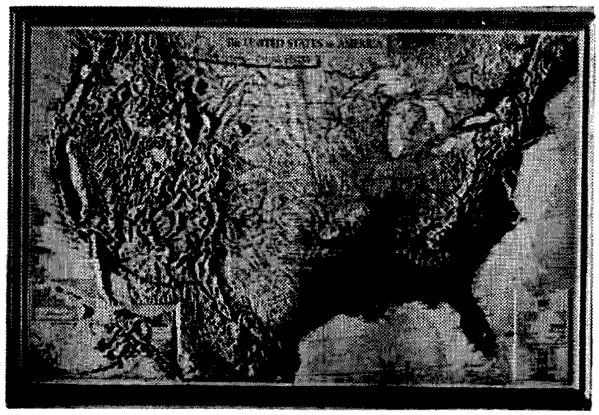

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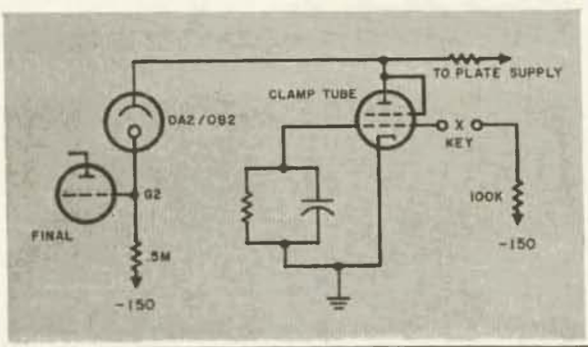
A Sequential Switch

Pat Miller KV4CI
P.O. Box 1853
St. Thomas, Virgin Islands

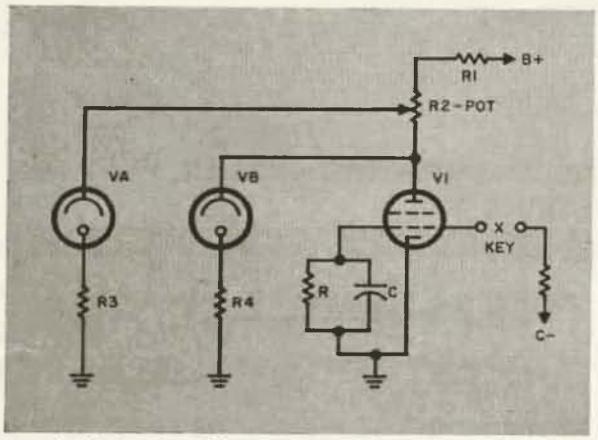
A popular method of clickless, spark-free keying using a combination of clamp tube and VR tube is shown in Fig. 1. By going a step further and using an additional VR tube and a potentiometer one can obtain a simple differential keyer as shown in Fig. 2.

The principle of operation of the circuit in Fig. 2 is as follows. When the key is up there is no bias on V1 causing it to draw heavy current through R1-R2. This high current causes the voltage drop across R1-R2 to be so high that there is insufficient voltage appearing at either Va or Vb and they thus remain extinguished. When the key is down a bias is impinged on the grid of V1 causing the current to drop along R1-R2 with a consequent voltage rise along same. Depending on the values of R and C the voltage will continue rising with Va first firing and conducting current through R3 and then followed by Vb firing and conducting current through R4. Reopening the key removes the source of bias, with the bias remaining on the grid of V1 decaying at a rate determined by R and C. The current through V1 once again starts rising causing the voltage to drop along R1-R2. As the voltage drops Vb is the first tube to extinguish as the voltage at any given moment is always lower at Vb than it is at Va. Shortly after Vb extinguishes it is followed by Va. From this sequence you can see that you have first an "On A" followed by an "On B" followed by an "Off B" and "Off A" as used in most differential keying systems. The circuit as described in Fig. 2 could be used to key the screen of the oscillator with Va and the screen of the amplifier with Vb.



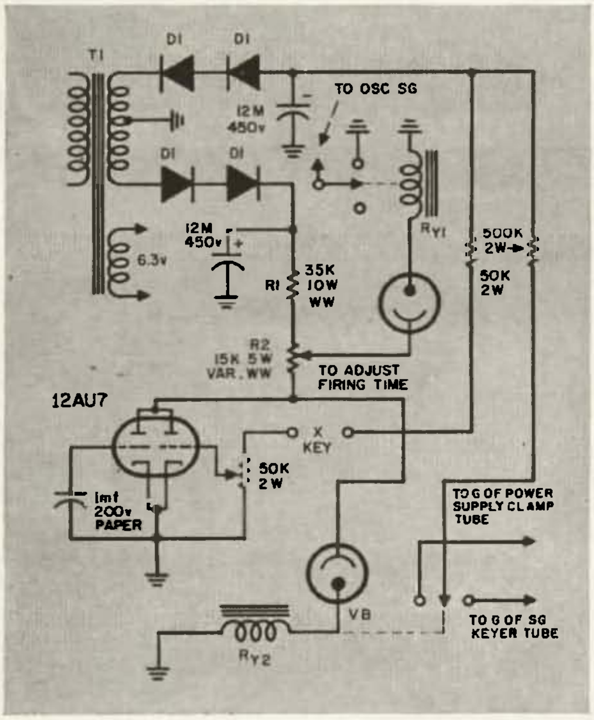
At KV4CI the system used in Fig. 2 is the heart of a slightly more elaborate system as shown in Fig. 3. High impedance plate relays substitute as loads for Va and Vb, thus allowing me to throw a bias voltage from one circuit function to another while maintaining a sequential keying action. RLY1 and RLY2 are SPDT types. Under key up conditions RLY1 grounds the screen of the VFO while RLY2 maintains a bias on the grid of a tube that vacuum tube keys the screen of my 4-125A final. With the key down RLY1 ungrounds the VFO screen grid voltage, allowing it to oscillate. RLY2 switches bias off the grid of the SG keyer tube allowing it to conduct and puts this same bias on the grid of a power supply bleeder clamp tube. (See Jan 61 73 Page 56.) The time sequence of keying is controlled by the settings of the potentiometer R2 and the values of R and C as used in the grid of V1. The system has a great deal of flexibility. Here at KV4CI I am able to vary the keying time from zero to about 120 milliseconds. One warning however in regard to gaseous type tubes. They are temperature sensitive and if you live in a climate where the temperature in the shack varies a great deal you may find it necessary to reset R2 from time to time to obtain your desired sequence time.

The reader with a sharp eye can see other

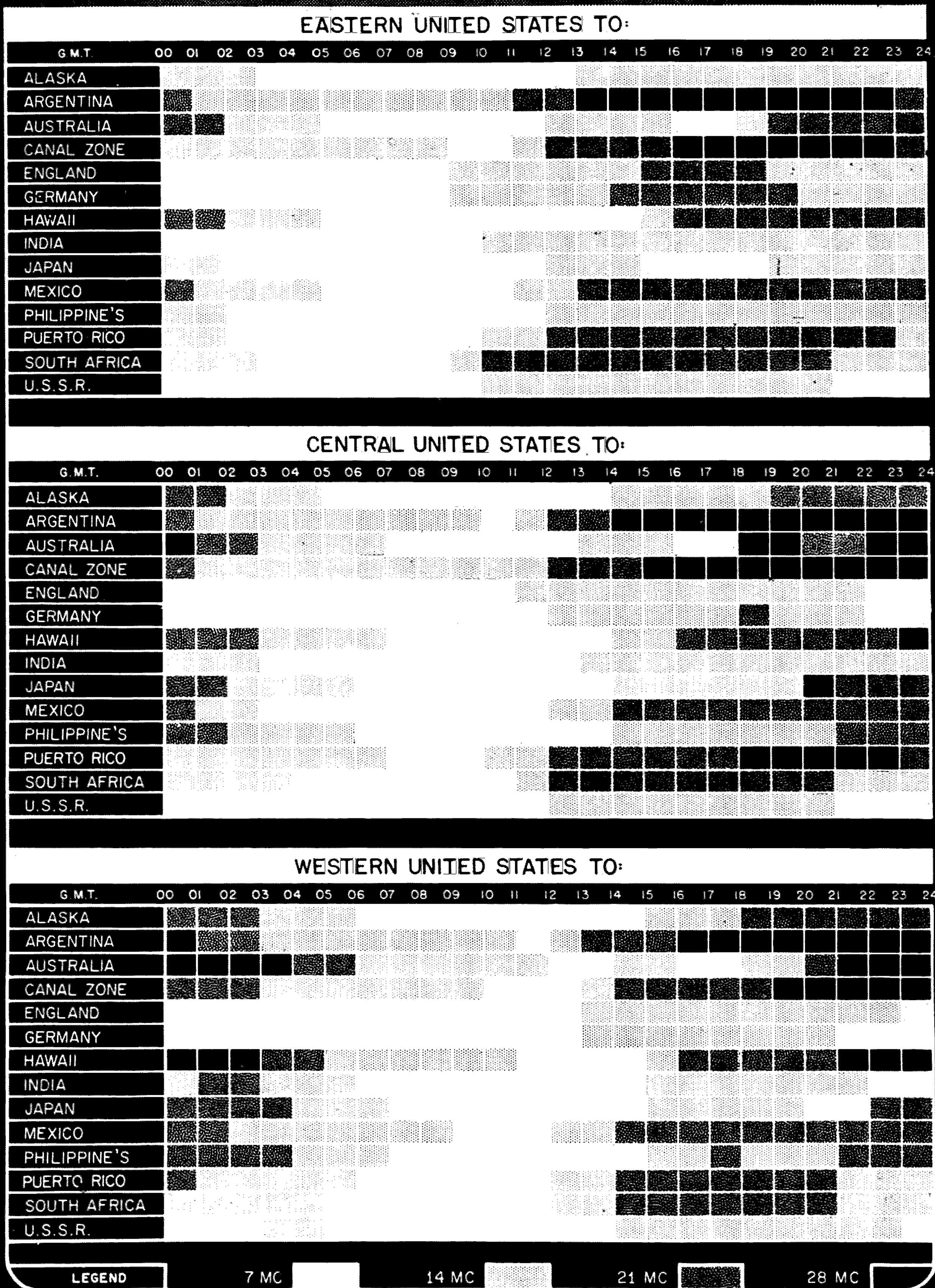


possibilities in this system. For example there is nothing to stop one from using a series of VR tubes attached to a multi tapped resistor in place of the potentiometer at R2. In doing so one could turn on a series of circuits in one sequence and extinguish them in reverse sequence.

The circuit in Fig. 3 is more elaborate than need be. The power supply shown was used as it was compact and available. Any bias supply giving 150 volts or so at a few mills along with a source of 250 volts positive at 30 or 40 mills will more than do the job for you. You will note that type 5651 voltage reference tubes were used to operate the high impedance relays. This was done because the relays operated best around 2.5 ma, just about the center of the current handling range of the 5651. However, lower impedance relays along with either OB2 or OA2 type VR tubes can be used with equal success. Come to think of it the circuit as shown in Fig. 3 could be used as a "see-saw bleeder-differential keyer for your driver power supply! . . . KV4CI



PROPAGATION CHART



Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

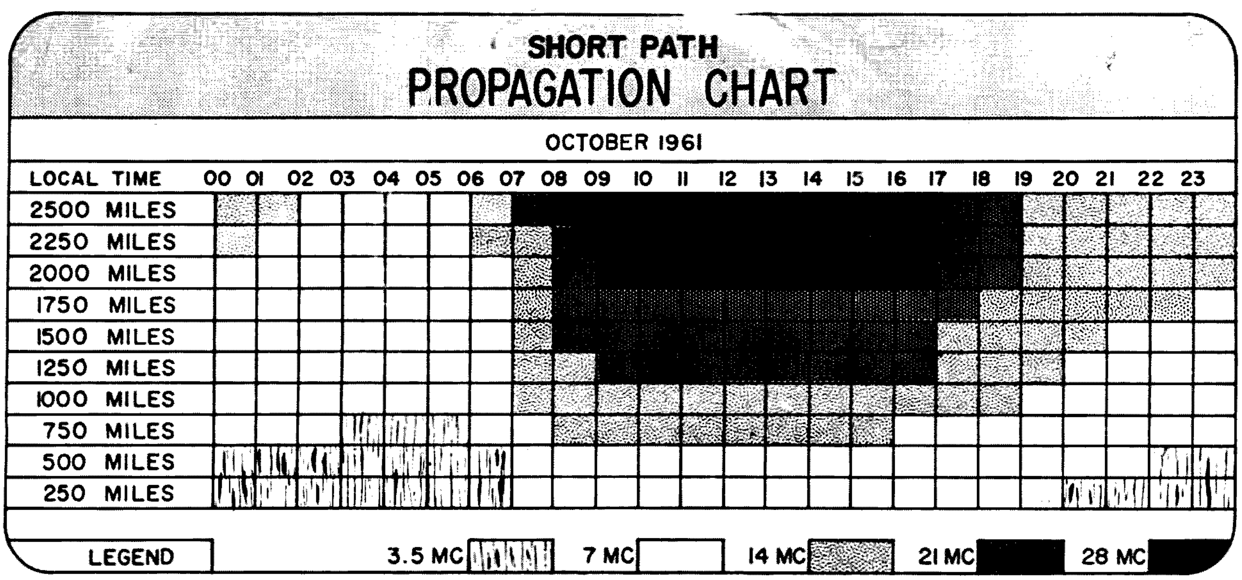
Advanced Forecast, October 1961

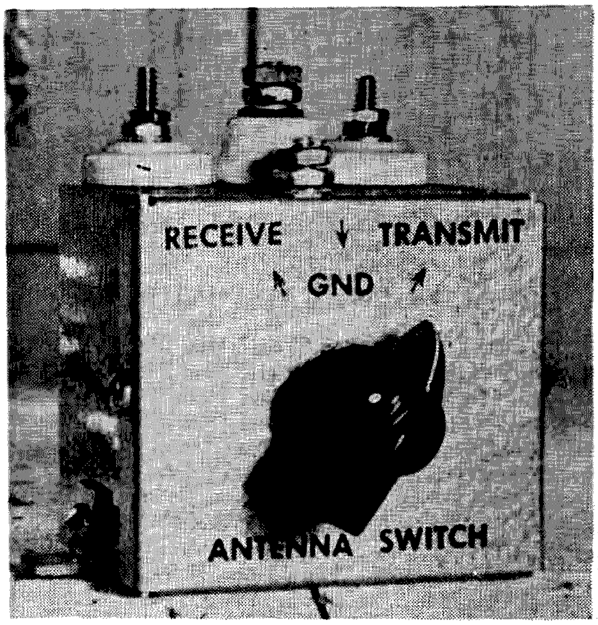
Good: 3, 5-21, 24, 25, 28-30

Fair: 1, 2, 4, 22, 23, 26, 27, 31

Bad: none.

The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earth's curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HGF's next to the 1250 mile listings will give the HBF to use and the time periods given will be the same at each end of the circuit. B.) To work the path New York to San Francisco (2,600 miles), the local time centered on the mid-point of the path will be 1½ hours later than at San Francisco and 1½ hours earlier than in New York (the time difference between New York and San Francisco is 3 hours). Looking up the HBF's next to the 2,500 mile listings will give the HBF to use. In San Francisco subtract 1½ hours from the time periods listed for local time and in New York add 1½ hours to the time periods listed for local time.





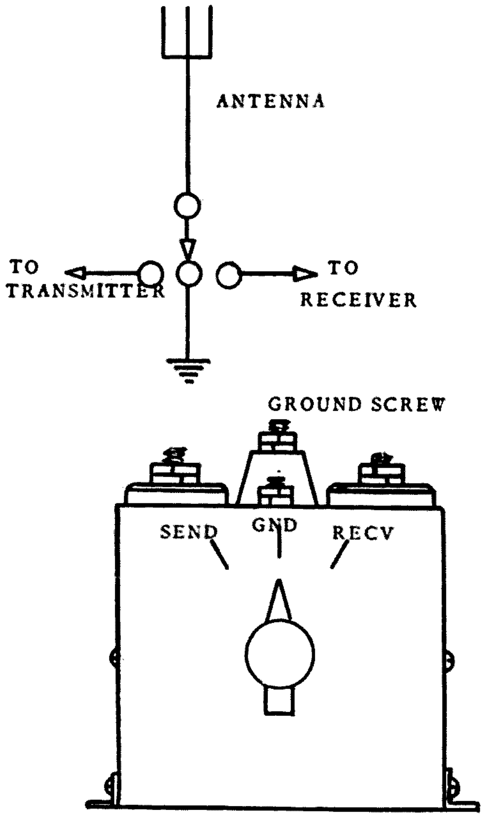
Simple Send-Receive Ground Switch

Howard S. Pyle W7OE
3434 74th Avenue, S.E.
Mercer Island, Washington

A large number of hams prefer to use the same antenna for both transmission and reception. In the more advanced ham stations, such change-over is accomplished either by means of a relay of some magnetic type, often co-axial and of late, an 'electronic' type, vacuum tube operated. In the magnetic type of relays, many go so far as to key the relay coil if they don't object to the clatter of the relay as it follows the keying. For phone operation (usually with 'push-to-talk' switching), relay clatter is of course, no problem. With either the electronic or the keyed-coil magnetic types, break-in operation is possible. So-called 'voice operated relays' also provide some advantages to phone operators but are somewhat more complex and a bit beyond the scope of this article.

Whether a simple switch, serving to shift the antenna from transmitter to receiver and vice versa, or whether such switch is used to actuate a relay whose contacts perform the actual switch-of the antenna, is of little moment. Either method will *not* permit break-in operation. Customarily the Novice amateur prefers to start with a simple single pole, double throw switch, frequently of the knife type with either a ceramic or bakelite base. While these are perfectly satisfactory in their electrical function, they do present some disadvantages. It is often somewhat awkward to make the complete 180 degree throw for each alternate period of transmission and reception. If the switch is located conveniently to operate, usually adjacent to the key, it is possible to get nasty little rf burns during transmission periods should your hand accidentally contact the exposed metal parts of the switch.

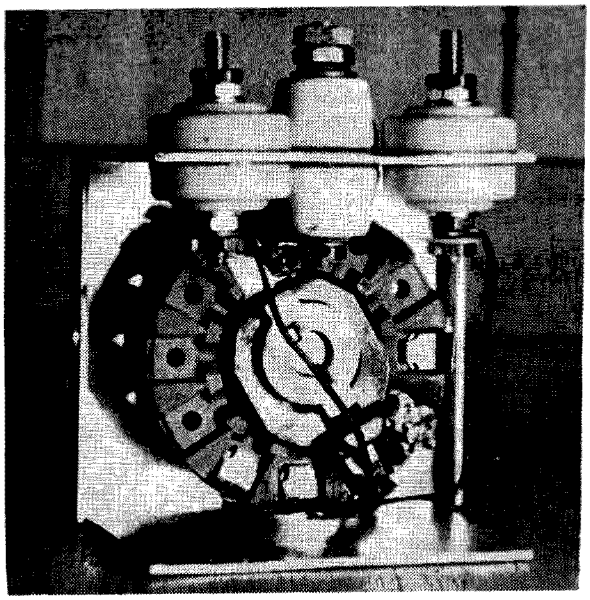
The writer recently had occasion to design and build a small switch for direct antenna change-over and which was to be used with a transmitter of 120 watts input. At the same time it was considered desirable to provide for grounding the antenna through the same switch during periods of station inactivity. The problem was quickly, easily and inexpensively



Direct switching.

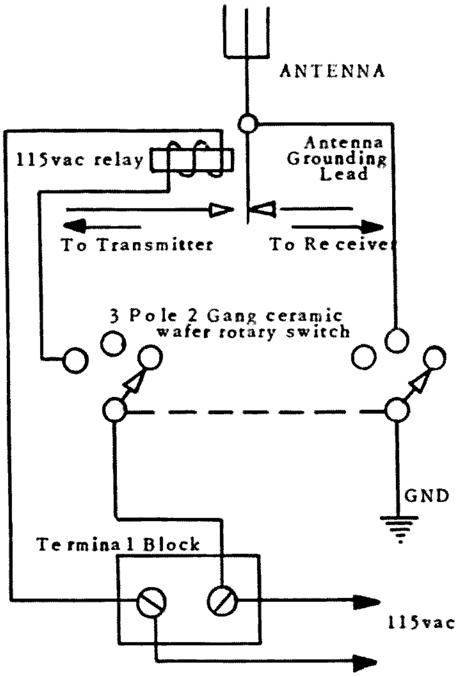
solved in the manner shown in the accompanying illustrations which are self explanatory. Parts readily available in the station junk box were used. Obviously, other parts of similar style may be substituted from what you may have on hand or purchased to suit the builder's taste. For example, the writer used an Ohmite Model 111-5, non-shorting power tap switch as it was available. Although this is a 5 point switch, only three taps were used as will be obvious from the accompanying illustration and schematic. Any ceramic base rotary wafer switch such as Centralab #2507, Mallory #174C or similar, will serve as well.

An LMB #00Z box chassis, only slightly over 2" in each dimension, finished in grey hammartone, formed the enclosure. Feed-through insulators on hand turned out to be two E. F. Johnson Co., #135-55 button type for the transmitter and receiver connections and one of their #135-44 for the antenna lead itself. The knob of course, can be anything which pleases your fancy; the writer used an Insuline Corporation pointer type, #1274. Small angle brackets were attached to the bottom of the two sides of the cabinet with which to secure it in position on the operating table. The 'professional touch' was added by applying small decalcomania transfers (any ham radio store) to identify switch positions and terminal connections.



As shown in the schematic, with the switch connected as indicated, you need merely throw it to the left to transmit, to the right to receive (reverse this if you like). Placing the switch lever in the center position connects your antenna directly to ground, automatically removing it from *both* transmitter and receiver.

The same type of switch can be made up using co-axial connectors if that is what you prefer. Follow the same general idea but provide a somewhat larger cabinet, such as the LMB Chassis box #000, and substitute female co-ax connectors for the feed-through insula-



Relay switching.

tors shown.

Again, should you wish to use such a switch to actuate an antenna relay and yet retain the grounding feature, use a *two* deck, 3 pole rotary type; this need not be ceramic as it will handle no rf. You may have to get a *four* position switch however, as three pole are somewhat uncommon. At any rate you'll use but *one* position on each switch (electrically). This is necessary however to accompish the desired functions. You'll find a large choice in these switches at any ham store or in the mail order catalogs.

You may wish to mount your relay right in the switch cabinet making a compact assembly; if so, provide a two-point terminal block somewhere within the cabinet and feed it with ac through a grommetted hole in the back. If you plan to use an *external* relay, install a *four*-point terminal block. The additional two terminals will provide a handy method of terminating the coil leads of the relay and leading them to their terminations within the cabinet.

Remember too, that if you expect to use a *two* deck switch to control the relay as previously described, you will need a somewhat larger cabinet to accommodate it. The LMB #000 or its equivalent will handle this; very possibly the same box will leave room for the relay as well if you plan to enclose it, unless your relay is somewhat oversize. If so, shop around for a box to fit; they come in a wide variety of sizes and finishes.

One last point; if you mount the relay *externally*, you'll need only *one* feed-through insulator (or co-ax connector as you prefer) in the cabinet, through which to bring the antenna grounding lead (Fig. 2), to the proper switch point. That does it; happy change-overs! . . . **W7OE**

(W2NSD from page 4)

means sending the page proofs back to the printer with all remaining corrections and the page numbers on them. These come back in a day or so for one more final check.

The procedure on ads isn't quite as complicated, but we have to have many of them set in type and go through just about the same thing. When you multiply all this by the fifteen to twenty articles per issue plus the ten or fifteen ads we have to have set you can see where a large hunk of time and energy is invested every month. Somehow, in the remaining time, we process all subscriptions and renewals, answer about half of our mail, bug advertisers for ads, clip out the readers service cards and send 'em to advertisers, count up the votes for articles, write editorials like this, bill advertisers for the ads, bill distributors for the copies we send each month (half our circulation is via radio parts distributors, some 800 of 'em), keep the books on all 800 distributors and 60 or so advertisers, put the monthly checks from all those advertisers and distributors in the bank, fill out voluminous forms for the post office to let them know each month just exactly how many copies we are sending to each postal zone in the country and how much this weighs (to the millionth of a pound), talk to visiting hams who drop in or phone, hunt high and low for stencils for subscribers that have missed a copy, change about ten to twenty addresses a day, pull out expiring stencils and send warnings, make up the mailing strip of all subscribers each month plus labels for all the distributors, and about two thousand other problems. Oh, yes, I musn't forget going to Conventions and hamfests.

(Turn to page 70)

(W2NSD from page 69)

Impedance Bridge Diagrams

The diagrams for the construction of the Impedance Bridge in the August issue were printed in microscopic size for two reasons. First of all we had to fit the article onto eight pages since we had to print it three months before we used it and then insert the eight page section later. Secondly something went wrong with our art department and the drawings were marked up for much too small a cut. By the time I had found out what happened and had gotten over my hysteria it was too late and we owned a couple hundred dollars worth of miniature cuts. Rats! What do you do then? You shudder at the reaction of the readers and vow that this wont' happen again.

Those of you who are interested in getting full scale (mostly) plans for the bridge can get them by sending in one dollar to cover the cost of handling, mailing, printing, etc. We have them ready for you now.

Reciprocal Licensing

Those of you who have followed my editorial meanderings down through the years know how dear this subject is to my heart. Well, it is finally getting somewhere. Someday I'm going to sit down and chronicle what I've gone through on this. This will lead to a lot of emotion though for there have been some important heel draggers, guess I'd better not. We'll write it up some day and have it published posthumously . . . like my chronicle of the "Operation Worldwide" which I've never dared let myself even mention in print.

Senator Barry Goldwater has introduced a bill to permit reciprocal licensing of foreign amateurs who are residents of nations who extend similar privileges to American hams. The bill was introduced August first and referred to the Committee on Commerce. This means that it is now entirely up to you to put the pressure on to get this bill through that committee. You do this by writing to your congressman and telling him you are interested in its passage and asking him to help expedite it. If you have a Congressman from your state on the Committee you can write directly to him and this will have an even greater effect.

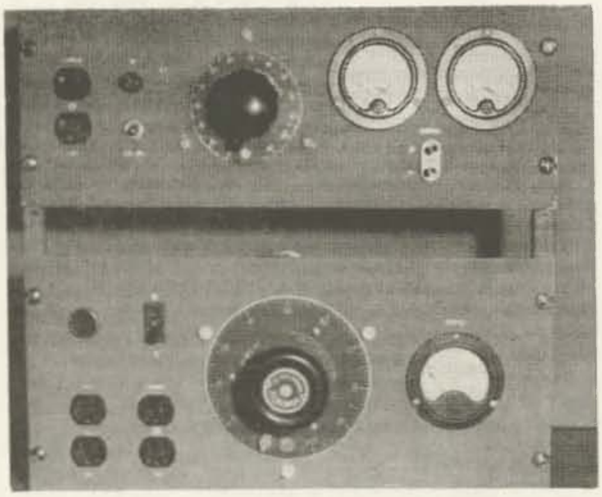
Senate Bill S.2361 proposes to amend sections 303 and 310 of the Communications Act of 1934. The amendments would permit the FCC to license foreign hams for up to three years in the U.S. if they are convinced that it would not endanger our security.

Why all the fuss? Why should you bother to write? Why should make it your business to see that everyone in your club writes, that your family writes, and that every ham you contact on the air writes? 1) The next Geneva Conference is coming up in a couple of years and we are being no less than foolhardy to do less than we can to get every foreign ham to

support the U.S. position for amateur band allocations. Right now there is a lot of bitterness overseas about the strict U.S. policy of NO FOREIGN HAMS operating in the U.S. I have visited these countries, talked to amateurs in a position to know, and interviewed many of their representatives at the last international conference at Geneva. 2) Permission to operate will no doubt lure many DX hams to visit the States and will allow them to really get to know us when they do visit. This will implement the Presidents' plan for having more foreigners vacation in the U.S. and will make for a lot better understanding between the U.S. and nationals of other countries. How many times have we read what some returning foreigner has had to say about his visit to the U.S. and wished that we could have done something to make him know our country better. 3) Once we are able to license foreign amateurs coming to the States our amateurs will in turn be able to get licenses in most foreign countries. This will greatly encourage foreign travel and will enable our amateurs to meet and talk to local foreign hams during their travels. I have visited many foreign cities and wished that there was some way to get acquainted with the local hams, hams that we can only infrequently contact from over here. 4) The prohibition against aliens being licensed that is now part of the Communications Act of 1934 was originally put in to prevent commercial companies from hiring much lower wage Mexicans to operate wireless stations. They had not even thought of this being applied to ham radio, which was almost unknown at that time and certainly was not portable. This minor oversight has grown with the increasing popularity of ham radio to be a major thorn. It is about time that it be corrected. It can be corrected if you take it upon yourself to see that it is. We have a lot of amateurs that are going to resist writing through sheer inertia and it is up to you to keep pushing them until they move to help our hobby in spite of themselves. Here is your golden opportunity to do something positive to keep ham radio going in 1964.

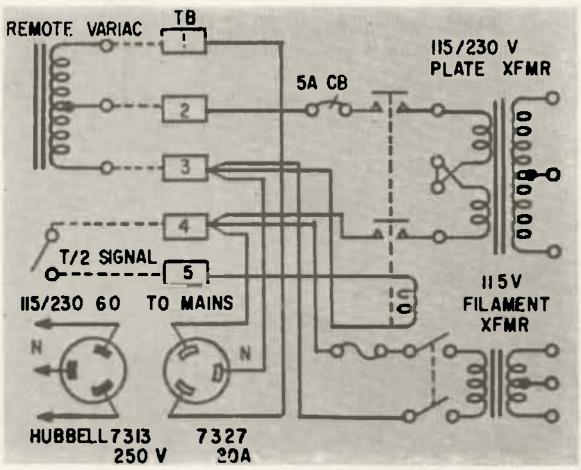
The members of the Interstate and Foreign Commerce Committee are: Warren G. Magnuson (Washington); John O. Pastore (Rhode Island); A. S. Mike Monroney (Oklahoma); George A. Smathers (Florida); Strom Thurmond (South Carolina); Frank J. Lausche (Ohio); Ralph W. Yarborough (Texas); Clair Engle (California); E. L. Bob Bartlett (Alaska); Vince Hartke (Indiana); Gale W. McGee (Wyoming); Andrew F. Schoeppel (Kansas); John Marshall Butler (Maryland); Norris Colton (New Hampshire); Clifford P. Case (New Jersey); Thurston B. Morton (Kentucky); Hugh Scott (Pennsylvania).

(Turn to page 74)



Maximum Utilization from Variacs

Tom Snyder W4CAG
Route 1, Box 286N
Titusville, Florida



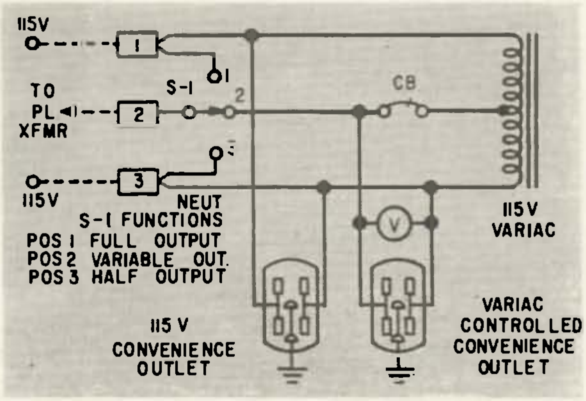
When a Ham finally takes billfold in hand and goes out to acquire his first adjustable line-voltage transformer, the event represents a significant milestone in his progress along the road of amateur experience and proficiency. This article proposes to show some ideas on how a Variac may be most effectively and flexibly used. In particular, it is a simple matter to get your Variac off the bench by building it into apparatus which requires a source of variable line voltage, but still to retain its capability of controlling soldering iron heat, testing unknown transformers, etc. Also, for many amateur applications, a 115-volt, 1 kv-a Variac may be used to control a 230-volt, 2 kv-a load.

Figure 1 shows how a 115-volt, 5-ampere Variac may be used to control a 1-kw rectifier. In the usual case, it is not necessary that the voltage be adjustable all the way to zero. Here, the Variac is connected across half of the 230-volt line, with the 230-volt primary of the plate transformer connected between the output of the Variac and the *other* side of the 230-volt line. It is necessary that no neutral connection be made to the center tap, if any, of the transformer primary.

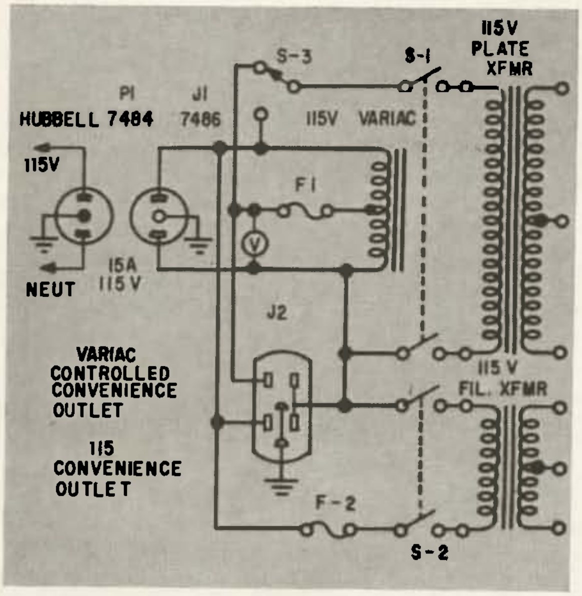
Rather than being built into this rectifier, the Variac is located remotely and connected into the circuit *via* a terminal board, to which the necessary power line connections are brought. With the Variac connection shown, the output of the rectifier may be varied from 50- to 100-percent of the rated output of the transformer. With the usual 30% over-voltage connection of the Variac, the output is adjustable from 50- to 115-percent of rated.

Figure 2 shows how the remote Variac, appearing in Fig. 1, may be mounted on its own panel, together with convenience outlets and an ac voltmeter, plus a switch, so that the Variac may be used to control the remote load, the convenience outlets, or both, as circumstances may require. Separate fuses, or circuit breakers, as shown in the figures, are desirable, since the rectifier and the Variac are each protected for all configurations. The convenience outlets shown are the new NEMA 3-wire grounding receptacles, which will accept either the older two-wire parallel blade ac plugs or the newer, more desirable grounding plugs. Most power tools are now coming equipped with grounding plugs which provide a third wire for earthground connection of the appliance frame.

Figure 3 shows how a Variac may be mounted within the apparatus which it is primarily intended to serve, but still power a convenience outlet, either separately from, or in conjunction with, the main load.



If S1 is shorting type, breaker must be open before changing switch position. If not it will open itself, but contacts on S1 will be burned.



In case panel space does not permit *two* convenience outlets, as are used in the circuit of Fig. 2, but it is still desired to provide one outlet at full line voltage plus another controlled by the Variac, some models of the dual outlets contain a removable link which will permit the isolation of the two circuits. The neutral and ground remains common to the two sections of the dual outlet.

The photograph shows a couple of pieces of equipment that I have built and which employ circuits described above. The upper unit is a low-voltage high-current supply, in which the primary function of the Variac is to adjust the input voltage to the rectifier transformer. However, this rectifier is used only for battery charging or occasional experiments with direct-current, and to avoid unnecessarily tieing up this 5-amp Variac, I added the convenience outlets shown. The lower panel mounts a 115-volt 20-ampere Variac whose primary function is controlling the output of a plate power supply for a 4-400A rig, but which is also made available for odd jobs. . . . W4CAG

Meter Shunt Winding

Trouble making shunts for meters? One big problem is in anchoring the end of the wire. Solderless lugs are the answer here. Clamp one end of the wire in a solderless lug and attach it to one terminal of the meter. Slide another lug on the wire and attach it to the other terminal. You can set up your meter and slide the shunt wire through the lug until you get the right reading and then clamp down the lug.

. . . K8BYO

X-sistor Symbols

In a previous issue of 73, transistor symbols were given. One important thing to add for newcomers to transistors who get mixed up on polarity and ruin a unit or two is to remember this. The middle letter, i.e., NPN or PNP will tell you the polarity that goes to the collector, neg. or pos. . . . KØVQY

W2NSD from page 71

August Votes

Enough readers sent in votes for us to get a fairly vague idea of which article was held in least disdain. The Nuvistor converter article won, just as Nuvistor articles almost invariably win. Good grief, we must be selling a lot of those little thimbles for RCA. I sure wish one of *our* advertisers would come out with a competing product. Hey G.E., how about a Gnuvistor? K6YCX's article on the Drake receiver ranked second and possibly gave a bit of a boost to the Drake advertisement which ran away with the votes for the most interesting ad of the month. Anytime an editor of a ham magazine starts to wonder about whether he should run articles about new equipment he should note our August issue and the over 1500 votes for the Drake article. You fellows who grumble about these articles just repeating the advertising literature had better do something to popularize your position.

The September voting started off light, with Silicon Rectifiers by W100P and the Staff Crystal Oscillators almost even and the Simplescope close behind. Get those cards in quickly if you haven't sent them yet. The Central Electronics ad is already so far out ahead that there is no possible question about who won that little contest.

Tear the card out of this issue and get it in right away. Don't (sob!) forget to fill in all those advertiser squares too. Ahem.

Salvaging Surplus Speakers

ONE of the most common faults of the garden-variety small PM loudspeaker is a punctured cone. Since cost of reconing such a speaker is almost as high as that of replacing the entire unit, service-shop junkboxes are usually fairly full of these units.

If used normally, they produce strange and annoying rattles and squeaks. However, these speakers *can* be salvaged. Here's how:

If two or more speakers are mounted in the same enclosure, in fairly close proximity to each other, they will act as if they were actually just one large speaker. Audio power applied to them will be divided equally among the various speakers, and the power applied to each individual unit for a given amount of sound will be correspondingly reduced.

At the lower power levels thus made possible, the rattles and squeaks caused by the punctured cones don't show up. These effects are noticeable only when the speaker is operating near maximum rated power.

As an example, both the speakers shown in the photo have suffered cone damage. A mending-tape patch on one cone is obvious in the picture. However, with both in a single box, they can absorb the full 10-watt output of the modified Super-Pro without a single squawk. Either speaker, alone, begins to rattle at about the two-watt level.

The trick isn't limited to just two speakers; any number can be connected together. Voice coils can be connected in series, in parallel, or in a series-parallel arrangement to obtain whatever impedance level you desire.

. . . K5JKX/6

see page 13

Subscriptions

As announced a few months ago, clubs may send in group subscriptions at the rate of $2.50 per one year subscription in groups of five or more subscriptions. These subs must start with the next published issue and be for just one year. Orders for back issues should be sent in separately. By simplifying the procedure we can offer this reduced rate.

The regular subscription rate is $3 per year; $5 for two years; $4 per year for DX operators outside North America. All back issues are 50¢ each. Send your name, call and address to 73 magazine, 1379 E. 15th St., Brooklyn 30, New York. Include money.

Jim Kyle K5JKX/6

Construction

In case you haven't noticed, we're strongly in favor of homebrew equipment. We firmly believe that if more hams built more equipment, not only the individual amateur but our hobby as a whole (and indirectly, the nation and the world) would be better off.

However, being realists as well, we fully understand that many (we might say a majority) of the amateur population, 1961 model, have never built anything more complex than the simplest of code-oscillator kits.

This is no indictment of the poor hams—until now, there's been little emphasis on the fun of do-it-yourself equipment construction. And for a number of reasons, nearly all construction articles have taken for granted the reader's experience in the fine points of homebrewing.

This combination of events makes it a bit rough to get started on the homebrewing trail; either you have to follow only the simplest directions in the "for-Novices-only" departments of other magazines, or you have to take your chances on some inexperienced guesses if you tackle equipment more to your liking.

There's no need to let the situation get the best of you, though. After all, even the most experienced designers and homebrew artists were beginners at this business once. With a simple guidebook of do's and don'ts, to help you avoid the not-so-obvious pitfalls, you should do excellently on your first try—and giving you that guidebook is the purpose of this article.

Rather than giving a concise collection of "Thou Shalt Not"s in the manner of certain other publications which shall remain nameless, we're going to try to break this art down in a systematic manner and present the reasoning behind each hint. This, we hope, will help you reason out that infinite number of cases which we can't cover here (because we can't foresee exactly where you'll have troubles on any specific project).

A good starting point, for any project, is in the choosing of a chassis. The purpose of a chassis is primarily to hold the other components of the equipment in a fixed position; frequently, it also serves as a partial shield.

At the supply houses, chassis come in two basic materials, with two types of finishes for each. You can get steel or aluminum, either painted or unpainted.

In addition, you can build your own from sheet "tin" (really tin-plated iron), aluminum, copper, or even heavy cardboard (November issue.)

Do's and Don't's

Each of these materials has its own set of advantages and drawbacks; which you choose will be determined by the nature of your project.

In general, you want to choose a material strong enough to hold the weight of all the parts that will be mounted on it, workable enough to be easy to handle, and having the proper electrical qualities to best serve on a particular project.

For heavy transformers and the like, steel is almost a necessity. For most equipment, if you're using a store-boughten chassis, aluminum is adequate and much more easily worked. For small transistor projects, cardboard is ideal.

Those electrical properties mentioned a while back have to do primarily with shielding. In audio work you want to steer clear of steel and iron because they carry magnetic fields and can introduce much mysterious hum. Either copper or aluminum is fine. Naturally, if the chassis must provide shielding, it must be of metal.

We haven't said much about building your own chassis. If you do, copper is an excellent material, as is brass. Both of these take solder readily, while aluminum is rather difficult to make a good solder joint to even with the new aluminum solders.

With a chassis chosen, one of the next items to consider is the choice of tube socket types. The choice is wide: You have bakelite, low-loss mica-filled, phenolic wafers, ceramic, teflon, and a host of others. Which should you use?

Surprisingly enough, for all except high-power transmitters the simple phenolic wafer socket is one of the best. With this socket, you can make direct ground connections by folding down the metal tab and bonding it to the chassis. The improvement in performance gained through elimination of inadequate grounding more than makes up for any losses introduced by the cheap socket.

At higher power levels, ceramic is the material to use. It's virtually the only one that won't be harmed by excessive heat, and high-power stages can generate several hundred degrees in the socket areas.

For dc and audio circuits, and to a lesser degree for rf stages, turret sockets such as those built by Eby and Vector are excellent. They allow each stage to be assembled as a unit on the bench, before being installed in final position. The exact point in the frequency spectrum where the losses exceed the ad-

vantages differs from project to project, but it's safest to use conventional sockets anywhere above about 7 mc.

Your choice of transformers will probably be determined mainly by design requirements. However, transformer placement is sometimes critical and sometimes not. It's critical whenever you're dealing with low-level audio or with cathode-ray tubes (including sheet-beam and magic-eye types), since stray magnetic fields introduce all sorts of troubles into these circuits. The rest of the time, simply put 'em where they'll fit and forget them.

In critical circuits, it's best to breadboard the circuit in as close to final form as you can, before mounting the transformers. Then, with the unit operating (DANGER—HIGH VOLTAGE!) position the transformer for minimum effect on the rest of the equipment. Mark the position, turn the gear off, and tie the chunk of iron down in place.

About that verb "breadboard" we used: it's a carryover from the earliest days of radio, when most chassis actually did start life as bread boards of the kitchen variety. As used now, it means anything from making a bench lash-up of a trial circuit to a semi-final version of finished equipment. The distinguishing thing about a breadboard circuit is that it's not meant for performance but to find out how it'll work. As we used it, it means a semi-final version of the equipment, needing only the mounting of the transformers to be complete and final.

Going down our list, we come to wiring. This seems simple, but it hides many pitfalls—such as the time one of the editors shielded the grid leads of his final amplifier and discovered the rf had went!

Basically, wire comes in several sets of categories: bare and insulated, solid and stranded, shielded and unshielded, etc., etc. The problem is: which type do I use where?

In the interests of TVI-proofing, it's best to wire all power-carrying circuits with shielded wire. This means filament lines, B+ leads, bias lines, and the like.

Signal-carrying leads, though, take different treatment. If the signal is dc, you can use shielding. If it's low-level AF *insulated* shielding is a must. High-level ac in the audio range can be shielded or not as you like, while all rf leads should be bare wire if possible.

Incidentally, if you like neatness you can lace your wiring into a harness; however, rf wiring should *never* be cabled. Any lead carrying rf should go directly to its destination and should be kept as far as possible from all other wires. This gets difficult in a crowded chassis, but it's one of the key rules for avoiding instability.

Incidentally, again, when you mount tube sockets you can prevent many later troubles by simply making certain that the pins are so oriented that no signal-carrying leads cross each other, and that all signal leads can go straight to their destinations. Failure to observe this point can result in many hours of searching for troubles that seemingly can't possibly exist—but do!

By now, we're up to the major components: coils, capacitors, and resistors. Since each of these is available in many different styles, the choice of which type to use is frequently perplexing.

Let's look at resistors first (they're simplest). Here, we have only two major types available: composition, and wire-wound. Less widely available and higher in price are deposited-carbon types.

A good rule to follow in choosing resistors is to use the composition type at all times, except in power circuits where the wattage rating needed is available only in wire-wound.

The reason for this is that wire-wound resistors have inductance as well as resistance, and in any rf circuits this makes them unpredictable. If you standardize on composition units, you won't have troubles with wire-wound units somehow sneaking into your projects.

One exception to this rule is that occasionally, a project calls for wire-wound resistors. Whenever this happens, the text will explain why—usually, it's to take advantage of their two-in-one quality. But in general, it's safest to stick with composition resistors at all times unless a project specifically directs otherwise.

Now to coils—the next simplest. Here, we have several choices. We can use air-wound coils such as Air-Dux or Miniductors (or similar home-built items), air-core coils wound on tubing forms, or slug-tuned types. In the slug-tuned category, we have the choice of brass or ferrite core slugs.

At this point, we're treading on the edge of some very thin ice, since variations in characteristicss of coils can make a great effect in performance of the finished item. By far the safest course is to follow the recommendation of the designer—but what if *you* happen to be the designer?

These are the basic characteristics of the various types of coils: Air-wound—low rf loss, fixed inductance value, poor thermal stability. Air-core wound on forms—higher rf loss than air-core, fixed inductance, good thermal stability if properly designed. Slug-tuned—highest rf loss, variable inductance, fair to good thermal stability. In addition, the Q of a slug-tuned coil with the proper core is much higher than that of an air-core inductor.

In the category of slug-tuned coils, the choice is between brass and ferrite cores. Brass cores lower the inductance as the core is inserted into the winding, while the ferrites raise the inductance. Exact choice of a core is best made by checking manufacturer's literature, looking particularly at the recommended frequency range. Brass is usable at almost any frequency, but the ferrites work

best only over a narrow band which varies from core to core.

Be sure to keep coils away from metal objects including the chassis and any shielding, or if you can't do this then allow for the effects of the metal. This usually lowers the inductance and increases the distributed capacity; it's safest to dip the coil to frequency after it's in the circuit—this takes care of all the uncalculatable variables which change coil characteristics.

Finally, by a process of elimination, we come to capacitors (frequently called condensers, an obsolete term). These come in many kinds, and confusion is rampant even among experienced builders as to where and when to use which.

The major types include paper, mica, ceramic, silver-mica, electrolytic, vacuum, and glass capacitors. Trimmers are available in mica, ceramic, and glass-piston varieties.

Electrolytic capacitors are limited to medium- and low-voltage power supply circuits, since they have high losses. The other types, however, are more or less interchangeable—more frequently less than more.

Paper capacitors are most suitable for audio use, where they are employed for bypassing power leads and for signal coupling.

Mica capacitors formerly were the standard for rf work. They have been largely supplanted by ceramic types, but with the ceramics you have to watch your step. Most of them have a wider tolerance spread than most other capacitors (many are only GMV, which means the value marked on them is the minimum but the maximum is unknown). The type NPO ceramic capacitor, however, is available in 5 percent tolerance and can be substituted for any mica unit.

Silver-mica capacitors are specially processed, and if they are called for no substitutions should be made. They have excellent rf properties, and hold their value under conditions which would destroy most other types.

However, glass capacitors can be used in place of silver micas. Since glass units are considerably more expensive, there's no reason to make the substitution.

For general rf bypassing, the tiny disc ceramic has no equal up to about 150 mc. Its flat-plate construction holds inductance to a minimum; a paper unit of similar rating will be almost completely ineffective at frequencies above about 3 mc. In addition, because of its tiny size, the ceramic can fit into almost any space. If possible, it should be positioned across a tube socket to help shield input from output connections.

Above 150 mc, the button-type ceramic capacitor comes into play. With no external leads, it has almost no inductance at all, allowing it to perform effectively up to about 500 mc.

In trimmer capacitors, the ceramic type is

recommended because mica trimmers tend to change capacity with changes in the weather (glass-piston types are nice hut expensive and limited in maximum value). The NPO variety holds its setting regardless of temperature or humidity; temperature compensating types are also available but should be used with caution.

So far, we've examined capacitors, inductors, resistors, wiring, tube sockets, transformers, and the chassis itself. About all that we haven't discussed is the choice of tubes or transistors.

In case you're wondering, that's something we're not going to discuss at this time. The reason is simple—it's worth an entire article in itself. If you can't wait, though, here's a hint: invest in a good tube manual and pick out tube types which are as close as possible to the ones originally called for in such characteristics as input and output capacity, voltages, transconductance, and amplification. If it's a match in everything but the socket connections, the substitution will probably work. . . .

We hope this listing helps you get started on your own homebrewing project. Undoubtedly, you have many more questions that we have provided answers for. If you can't figure them out from the hints given here, drop us a line —and if the question is of wide enough interest, and enough of you have such queries, we'll undoubtedly run a sequel. In any event, you'll get a direct answer.

. . . K5JKX/6

Instant Band Change

MANY types of amateur operation, especially contest work, put a premium on being able to change bands with a minimum loss of time. One approach to this problem is a multiple-transmitter and -receiver installation, which is quite expensive. Another approach is to build transmitter with bandpass exciters, broad-band tuning, etc. This, still, requires a little more work to build than a conventional transmitter.

But all is not lost! Here is a simple idea that can be applied to any transmitter, homebrew or commercial, DX-20 to Thunderbolt. Model airplane dope may be purchased in a variety of colors. Some model shops carry assortments of eight colors plus thinner and brush for about 75¢. Simply take one color for each band and color-code the tuning controls. If you are careful, and do a neat job, it adds a nice touch of color to your front panel without looking gaudy.

Start out by tuning up on your normal operating frequency in one band (any band will do). Using one color of dope, put a small colored dot on each control, including the bandswitch, to indicate the proper setting. Then do the same thing for each band, using a different color dope for each band.

After this is done, to hop to another band, you simply set the bandswitch in the correct position, note the color for that band and set the controls on the matching color. Of course, the tuning may shift slightly due to aging of components, changing antenna load, etc., but with such a system you are able to set the controls to the approximate setting so it is a simple matter to touch them up to bring tuning right on the button.

If you need to change any of the dots later, such as would be required for a new antenna, the dots may be removed with dope thinner or fingernail polish remover, then replaced in the new position.

An advantage of this system is that visiting hams are able to tune your rig with no danger of burning out the fragile screens in those expensive little 6146 finals, or tuning up on a wrong harmonic.

If you want to use a system such as this with temporary, easily-removed markings, use different color grease pencils. Grease pencils may be bought in enough different colors to color-code the usual 160 through ten meter transmitter, and may be removed by rubbing them off with a soft cloth.

. . . Al Brogdon K3KMO/W4UWA

Equipment Refinishing

Although most quality communications equipment is finished to withstand long periods of use, the time comes when the equipment racks and cabinets should be repainted. Spot painting will prevent exposed metal from rusting although attempts at spot painting and touch-up may actually harm the appearance of the equipment.

At this juncture, it is wise to turn to the experts. Your local auto-body shop is fully equipped to perform just about any metal refinishing job. The mechanics are experts in restoring mangled metal to its original shape, matching colors and applying a finish, either lacquer or enamel, that is indistinguishable from the original. Give it a try. The cost is reasonable and a hard, durable finish is always obtained. . . . W4WKM

Writers Needed

No Talent

Necessary

We will be publishing the 1962 Almanac-Yearbook-Ham Buyer's Guide about midway between the November and December issues of 73. This book will be sent to all subscribers and will be available at radio parts distributors.

We will have listings of the postage rates to all countries of the world, QSL Bureaus, call prefixes, and just about anything else we can think of that is frequently needed. If you'll remember back to various things that you looked up recently you'll probably be able to send in a chart, list, table, etc., that others would find of value. This would get you a by-line in the BG and maybe a small gratuity, depending on how much work went into it.

If your club is planning an event for the coming year we'd sure like to list it. Maybe it is a picnic, hamfest, convention, contest, etc. Let us know the details and the date.

Prospective advertisers will find this BG the best advertising media yet invented. The cost is a mere $150 per page (every 4th page free) and we expect close to 100,000 copies to be distributed. Send for rates and details.

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Junk Box

Tips

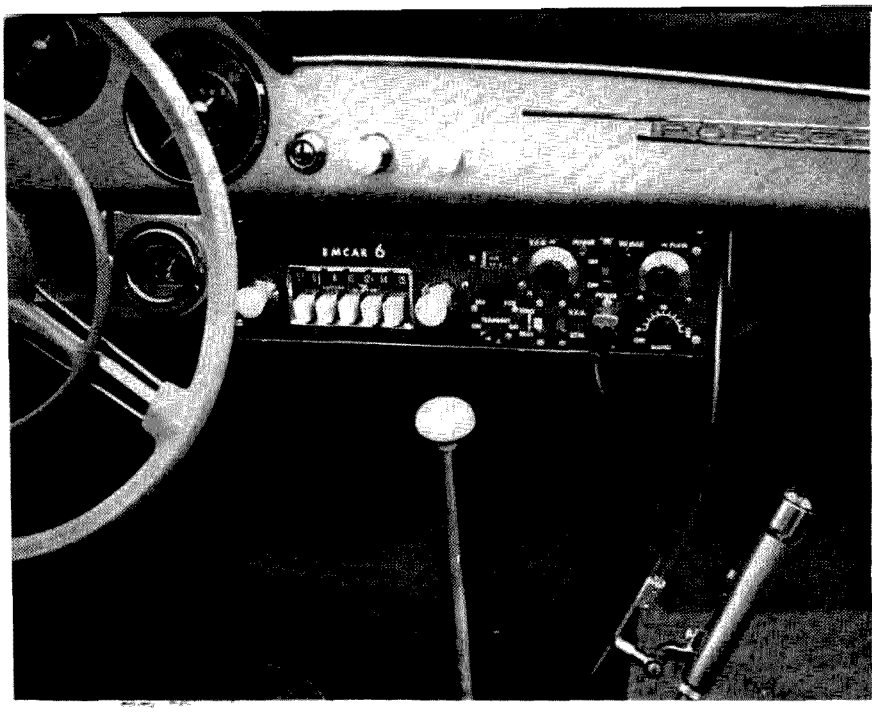
To those who possess coax relays from an ARC 5 (28 volt DC) and plan to use it on a small xmitter whose modulator is push pull 6AQ5's, 6V6's and etc. or a single 6L6, use the winding as the cathode 'resistor' of the modulator tubes. If your B— is broken in rec. position, then in transmit the mod. throws the relay.

This has been in operation on a 2 meter xmitter for 2½ years and still works.

. . . KØVQY

Save those transformers from old rotor control units. You'll find uses for them. One is a transistor power supply. With a bridge rectifier, you can get 30 volts plus at more than 30 ma. plus. . . . KØVQY

UHF TV is gone for a lot of areas. There are UHF converters (and probably) old TV boosters also. A majority of these contain a transformer that delivers 6.3 volts and 125 volts at 30 ma., that is isolated from the line. Preamps, bias supplies, small set supply and a load of test gear you can dream up can be built around this. . . . KØVQY



Emil Carp W3JXT
Montgomeryville, Pennsylvania

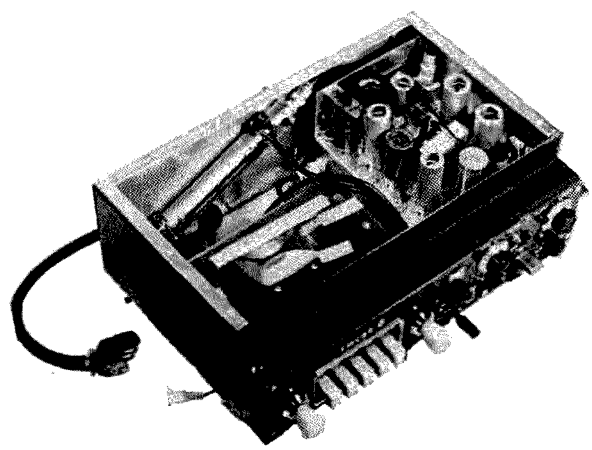
Emcar 6

(*for a Porsche*)

A couple of years ago I was intrigued by the description of how to buy a Porsche in Germany which appeared in an editorial by Wayne Green. The story influenced me to do the same.

After surmounting the minor obstacle of a boss who didn't want to give me time off for the European trip by convincing him to come along as my co-pilot, all went smoothly. The car was waiting for me at the factory and it was a dream to drive. We traveled 4500 miles through Europe, enjoying every minute of it.

Once the car was home, I started looking at it critically with the idea of putting in a mobile rig. Porsche owners, Volkswagen owners, and others who have to match wits with the restricted room problem may benefit from my solution. I fitted everything into a package 4" high by 13½" wide and with a panel only 2¾" high to stick out from under the dashboard.

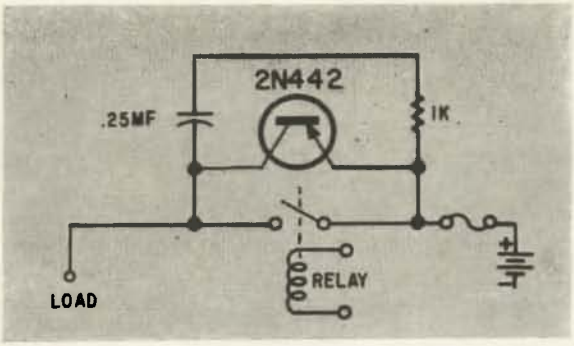


The receiver used was a Bendix all-transistor broadcast set made especially for Volkswagens. I had a Transcon six meter unit which was easily modified to fit in the new package, giving me a crystal controlled converter and transmitter combination. I had to lower all of the Transcon tuning controls and change the plate coil to a horizontal position to get it into the flat case. The vibrator power supply was mounted up front in the luggage compartment and relay controlled. I installed the transistor-condenser combination shown in Fig. 1 to suppress any arcs across the contact points. Perhaps I'm a worry-wart, but I get nervous when gas stations spill gas into the luggage compartment while trying to get it into the six inch wide racing spout on the gas tank.

An SWR unit was incorporated using a Lafayette AM tuning meter TM12. The plastic case was carefully opened and the resistor removed, leaving me with a 50 ua movement. I built the rest of it using the Heath SWR for a model.

I used 1/16th inch aluminum for the cabinet, bending each side and using sheet metal screws to fasten all the sections together. With the addition of flat bottom and top plates I had a rigid case. Holes in the plates provide ventilation.

The set mounted in the car easily. A small angle bracket on each end fastened to the bottom of the dash and a quarter inch bolt secured the back end to a bracket attached to the car. I used power plugs on the cables so I could take the rig out whenever I wanted with just a couple minutes work.



This is no place to go into ecstasy over the joys of mobile hamming, so suffice it to say the rig works fine and I wouldn't be without it. The Porsche is fabulous and I pity all you poor chaps who haven't had a chance to try the breed. . . . W3JXT

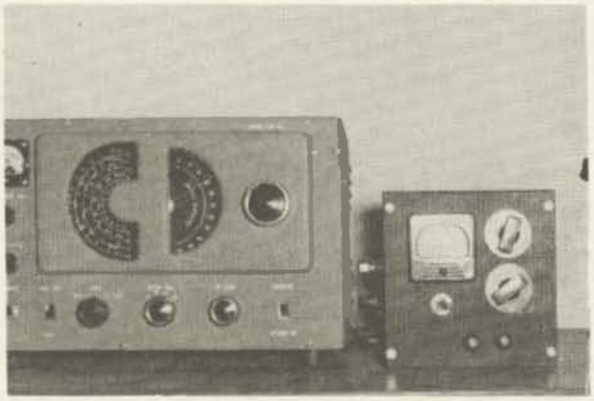
New Product

Battery Eliminator

Apparently EICO is trying to outdo everyone else in battery eliminator design. This new one has everything you can imagine. It is filtered with 5000 mfd for use with transistor radios and will handle the currents necessary to charge six or twelve volt batteries. It has two ranges, 0-8 vdc and 0-16 vdc, and the meters switch as you select the range desired. $43.95 in kit form and $52.95 ready to go. Load: 10 amps continuous and 20 amps intermittent on low range, 6 amps continuous and 10 amps intermittent on high. EICO will respond with full particulars on this or any other EICO product if you but let them know of your interest. EICO, 33-00 Northern Blvd., L. I. C. I, N. Y.

Edward Noll W3FQJ
Box 23
Chalfont, Pennsylvania

The Little Thief



A little rig comes in handy now and then. It may be used to let the fellows know what happened to you when the smoke started pouring out of the big rig, or it may be just for having a little fun down in the Novice bands. This Little Thief steals its power from your receiver, thereby reducing its cost and weight to a minimum.

Your receiver probably has a socket on the back for powering a calibrator, converter, Q-multiplier, etc., so why not plug in a small one-tube transmitter? This won't overload the receiver because the transmitter doesn't draw any more power than the receiver and is only used when the receiver is on standby.

Step one is to get out the manual on your receiver and see how they have the accessory socket wired. All receivers have at least the filament, ground and B-plus available here. You will need some method of switching the B-plus from receiver to transmitter. If your receiver does not have a double-throw switch built in, which it probably has not, you have a choice of either substituting one for the present standby switch or else mounting a suitable switch on the transmitter and letting it perform the duty. This is probably the best bet . . . and simplest.

Many receivers have the B-plus go through a jumper on the accessory plug. If you have one like this then your problems are few. All you have to do is remove the jumper and run the wires to the new switch and use that instead of the one on the receiver. If the manufacturer has been remiss you will have to do the work and break the B-plus lead as it comes from the standby switch in the receiver and run it to two empty terminals on the socket.

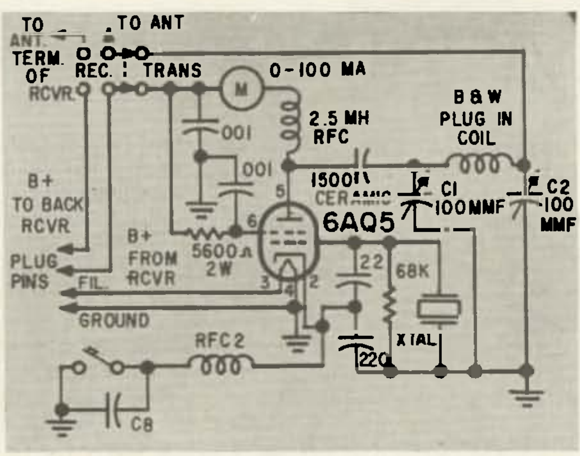
The Transmitter

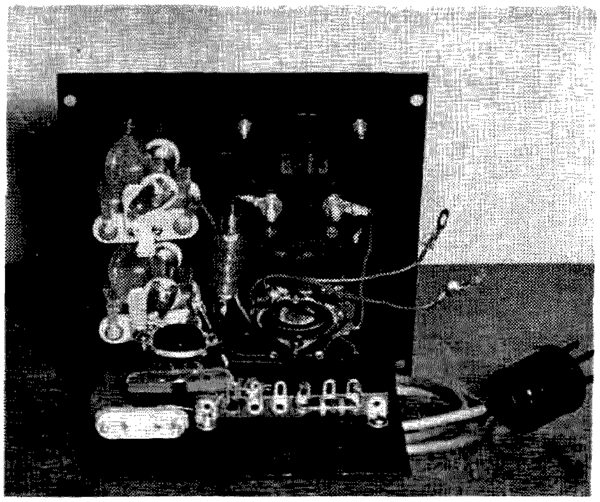
A single crystal oscillator stage is used with a pi-network tank circuit. This will match into random length antennas and give you good harmonic rejection. Both crystal and coil can be changed easily for band changes. A double-pole double-throw switch is used for transmit-receive so you can switch both the B-plus and antenna circuits simultaneously. This gives you one switch operation and you don't have to use any antenna relays.

A small pilot lamp could be used in place of the meter for tuning, but with the low price on meters this doesn't make much sense . . . and besides a meter is a lot easier to read. If you don't have a meter of the right range it is simple to wind up a small shunt and use any meter of lesser range.

Tuning

C1 tunes the tank, C2 determines the loading. Tune C1 for a resonant dip on the meter and





then tune C2 for best loading. I find that a small field strength meter is very handy for getting the best loading. With experience you will see how the plate meter responds to loading and be able to tune by it alone. C2 will affect the tuning of C1 a bit, as you will see. On 40 meter C2 has a greater effect on tuning and you may have to try several different settings to determine the best output. For best stability of the keyed note you should back off the maximum dip just a bit with C1. Experience is a fine teacher and this little rig will be quite an experience.

With a 65 foot antenna and proper loading on both 40 and 80 meters I found that 12 ma plate current gave me the best results.

. . . W3FQJ

Coil Forms

For you newcomers, save the IF's from old TV sets, these make good coil forms for your next converter. . . . KøVQY

1625's

A very versatile tube is the 1625, or 12 volt version of the 807. It can be used in many applications to replace 807s in finals, or most of the common modulator tubes in the medium power class. The tubes sell for approximately 25¢ surplus and have a large number of practical uses. One of them would be to replace 6L6s and tubes of a similar type in modulators. The 6L6s list for about $4.00 and the difference between a pair of these and a pair of 1625s will more than pay for a filament transformer with plenty left over. The difference is even greater when replacing them. It should be noted that although the 1625s will replace 6L6s, they are also good for considerably more power. A pair of them in class B will give about 120 watts of audio. When planning a rig, it might pay to consider the use of these tubes. . . . WA2INM

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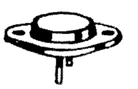

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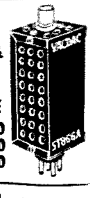

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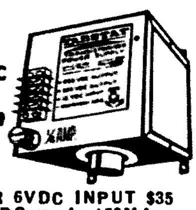

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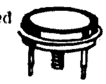

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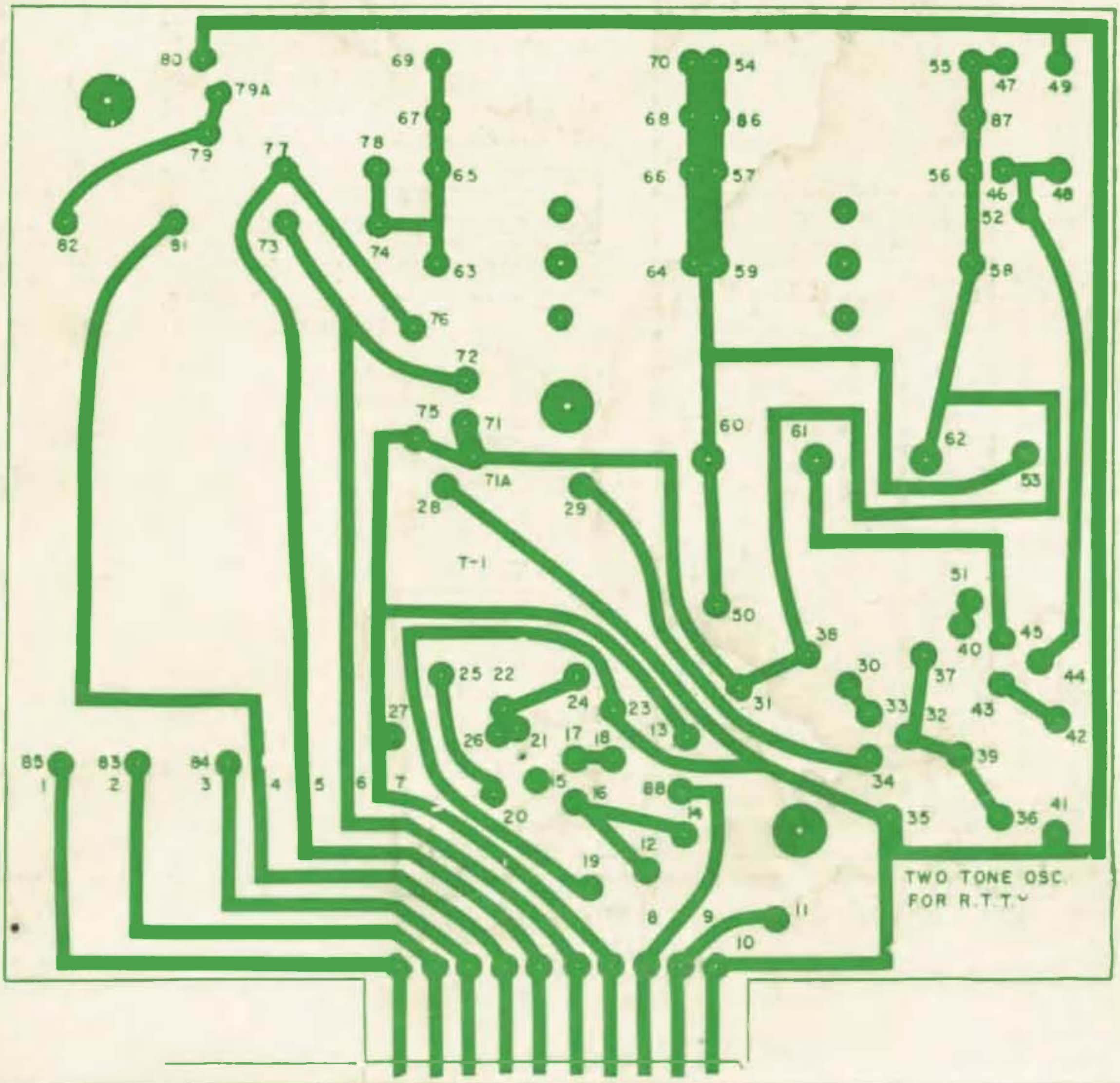

73 Magazine

1379 East 15th Street—Brooklyn 30, New York

Wayne Green W2NSD—Editor, etcetera November 1962 • Vol I, No. 14

CONTENTS

Linear for Sunspot Lows .... Bill Cronkhite K6QQN & Bob Adams W6QMN 6
Do-it-yourself F2 layer. A kilowatt six meter linear for SSB.

Transistor Mike Pre-Amplifier .... Glen Malme K6PZT 10
Outboard pre-amp to make up for audio deficiencies of your rig.

Transistorized RTTY Audio Oscillator .... Bob Barbay W5SFT 12
Printed circuit, generates mark and space tones for RTTY.

Have You Met These Characters .... David Heller K3HNP 15
TVI brings out some remarkable characters.

TV Tuner Receiver .... Louis Hutton WøRQF 16
The Standard Coil Tuner makes a wonderful basis for a fine inexpensive home made receiver.

Solid Power .... Jim Kyle K5JKX/6 20
What diodes to use for what voltage power supply.

Phasing For Audio Selectivity .... Jim Kyle K5JKX/6 24
Simple gadget makes the 80M Novice band sound almost vacant.

Quick and Simple Mobile Rig .... Jim Kyle K5JKX/6 30
CB is good for something! Convert those CB rigs to 6-10-15-20, 20M featured here.

Single-Sideband Transceiver .... William Goldsworthy W6BUV 33
All band, 200 watt PEP, VOX, etc. Everything you could want in a transceiver.

A Quad for Six .... Karl Brownstein W3TBF/ø 48
The quad works excellently on six meters too, and is awfully easy to build.

Evolution of Antennas .... Howard Pyle W7OE 50
Short history of the early ideas in antenna design and how they grew.

Propagation Charts for November .... Dave Brown K2IGY 58
What time, to where, when, on what bands . . . maybe. Incuding short haul inter U.S.

Two Uses for a Birdie .... Jim Kyle K5JKX/6 62
1) Super accurate alignment of if's. 2) Substitute for xtal standard for bandsetting.

Horn Antennas .... Eric Roy TI2NA 64
1296 mc requires an entirely different approach to antennas and feedlines .

Audio Hither & Thither .... Allan Joffe W3KBM 66
Connecting the tape recorder and phone patch into your rig and receiver.

Rewinding Relays and Transformers .... Ted Adams KøRRM 70
Rewinding for different voltages or in case of failure under the smoke test.

Surplus Utilization .... Roy Pafenberg W4WKM 72
General discussion: where to buy, what to buy, and how to best use it after you have it.

Testing the Gonset Communicator TV .... Charles Spitz W4API 80
Thorough rundown of this popular piece of gear.

COVER: Actual Size P.C. Board for W5SFT Oscilator.

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Misc. & Short Items:

de W2NSD 2
Letters 22, 57
XYL's Lament 29
Diode Polarity 49
Lifers 55
New Products 69
Those 3-D Maps 55
Subscriptions 56
RF Output Indicator 84
Advertising Index 86
MARS Technical Broadcasts 22

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. . . de W2NSD

(never say die)

Conventional

Many amateurs are naively surprised to learn that we cannot advertise 73 in other major ham magazines. Accepting this fact of life it is only reasonable that you should see my flashing smile guiling you into subscribing at every convention, hamfest and club meeting that I can manage to attend. After attending two highly touted abject failures in a row I began to ponder over what factors were present to keep the customers away in such droves. It didn't take much pondering for the whispers of dissent were loud and boistrous. It would seem that convention committees can assure themselves the best chance at the prizes by setting a $4.00 to $5.00 admission fee for the convention.

This astronomical fee is rationalized by the committee members who convince each other that the grand and glorious prizes they will buy with the proceeds will lure the ham out of his cellar and bring him eagerly to the convention, trailer in tow, in hope of going home with the complete kilowatt station. There seems to be a shortage of kilowatt station manufacturers who are willing to give these for door prizes, so the committee has to buy said gear and pass along the tab to the conventioneers. This thus becomes a giant raffle.

The committee agrees that, after all, $4 isn't very much these days. It is little enough to spend on that one glorious day a year when you go to a Ham Convention. Committee members, I have a news flash for you: $4.00 is still considered a *lot* of money by a *lot* of hams. You would be surprised how many of the lads don't have an extra $3 with them to subscribe to 73 at these conventions after they've been through the general admission ringer.

Why not apply reason to this business of buying prizes? Reason, in this case, as always, means that you should accept my views. One of the basic ingredients of the fabulously successful Dayton Hamvention is the welter of small prizes. A goodly percentage of those attending go home with something worth more than their admission fee. A chap who pays $2 to attend a convention feels wonderful when he wins a $3 prize. And these small prizes are a heck of a lot easier to pry from manufacturers than the $1,000 ones.

There are probably a lot of bargains around, if you take the time to look. For instance, if I were a Prize Chairman for a convention, I would get in touch with the Callbook Magazine and find out what kind of deal I could make for a hundred or so of a recent past issue. Or how about getting a price on a hundred or so 1961 ARRL Handbooks? With the 1962 issue coming or out they should be reasonable. Ham magazines should cooperate on a bulk subscription order of fifty or so. Manufacturers, if requested to send small items, would probably respond generously.

Now, with from 500 to 1,000 prizes, I would be able to distribute joy at the convention. I would have a list of prizes mimeographed and given at the door so the fellows could look over the list and see what they would most like to win. Numbers would be pulled every hour between technical sessions and the winners would have their choice of the remaining prizes as they came forward. The winning numbers could be posted on a bulletin board and sent to various parts of the convention floor via printers furnished by local RTTY'ers. Letting 'em make their own selection keeps the phone man from winning a bug and the DX man from going home not too gruntled with a mobile mount. And darned few fellows would be going home empty handed.

So much for the prizes and exorbitant admission fees.

The focal point of any convention is the exhibit area. This area could stand a lot more attention. Few manufacturers feel that a convention will do them enough good for them to spend $100 for a small booth plus the cost of shipping the equipment to be exhibited, travelling expenses for booth personnel, hotel expenses for same, and rentals of tables, chairs, curtains, tablecloths, etc., for the booth. When you add all this up it keeps most of 'em at home. This is why, out of over a hundred possible exhibitors, most conventions end up with a handful plus a couple local distributors and reps.

A little consideration and red carpet treatment would go a long way toward giving you a much fuller exhibition hall. Booth rentals should be kept as low as possible and not considered as a major source of income. $25 to $50 is reasonable for most shows of 1,000 to

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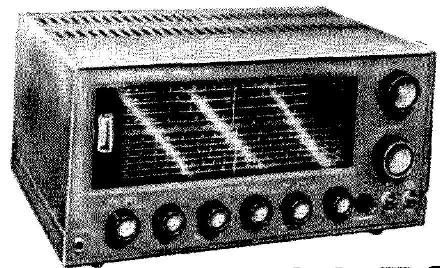

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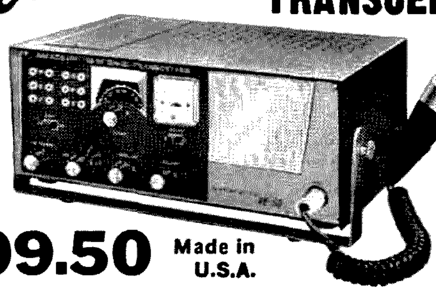

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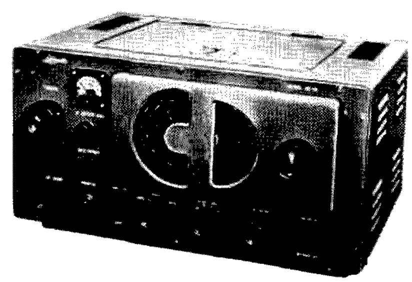

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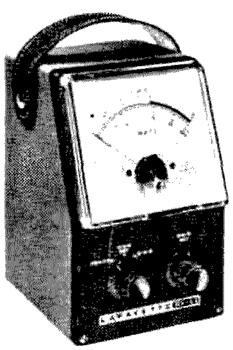

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2,000 actual ham registrants. Tables and chairs for the booth should be furnished at no extra cost, with rental units available if requested. Hotel reservations for exhibitors should be looked after. Badges should be prepared specially for them. Comes to mind the badges presented at the Swampscott Convention which were of the type made by K9TVA Enterprises, an engraved laminate. It doesn't take a lot of extra effort to meet the exhibitors at the airport and drive them into town, saving them the cost and confusion of the taxi or limousine ride. It also makes them feel a lot more wanted.

Once you have them delivered to the hotel, registered, and badged, then help them find their exhibit materials and set up their booth. Most manufacturers are experts on their particular type of equipment and it would be a nice gesture to allot them a few minutes of a technical session so they can extoll the virtues of their gear before an audience and answer questions. I assume that you will not be surprised to learn that they came to the convention with the idea that they might generate a few sales as a result. If they succeed in this you will find them a booster for your next convention.

Now, about those tickets to the grand banquet. Give a couple to each exhibitor. Manufacturers who frequent conventions rarely go to the dinners since they are already heavily out of pocket and an extra $5 to $10 per dinner doesn't make too much sense compared to the $2.50 he would have to pay outside. Even if he doesn't want to stay for the dinner he will appreciate the offer. You can further ingratiate your convention with him by reserving a good table for exhibitors and not just let him fend for himself if he does come to the banquet. If the convention is on such financially shaky ground that it is necessary to charge the exhibitors for the dinners, then the convention is being misrun. Some committees go as far as to charge their own members general admission and banquet fees. This is ridiculous.

To give you an idea of what lengths this sort of madness can go let me cite the case of the chap who spent months working hard on a convention. He sent out all of the promotion on it to exhibitors, possible program advertisers, and all of the radio clubs in the general area. He prepared the posters, the ticket order forms, the letterhead letters and envelopes, etc. He pinned down most of the exhibitors by phone and solicited most of the advertising for the program booklet by phone, then went on to publish the booklet, help manufacturers to set up their exhibits, and a hundred other small jobs. In addition to this he paid in full for his own booth. Came time for the banquet and though over $400 in the hole personally (never reimbursed) and in a very tight financial position with a new business of his own, the committe absolutely insisted that he and his wife

(Turn to page 77)

Six Meter KW Linear

for sunspot lows or do it yourself F2 layer

Bill Cronkhite K6QQN
1771 E. Mountain Street
Pasadena, California

Bob Adams W6QMN
Box 4, San Fernando
California

With the decline of the last sunspot cycle, F2 layer skip is a thing of the past, at least until the next cycle comes around. It falls upon the serious VHF enthusiast to compensate for the loss of natural phenomenon by extending his reliable range with more effective equipment. The use of the less spectacular modes of propagation will still be available to us throughout the sunspot low, and there is no reason why they can't be used to their fullest extent. One way to extend your reliable range is with high power.

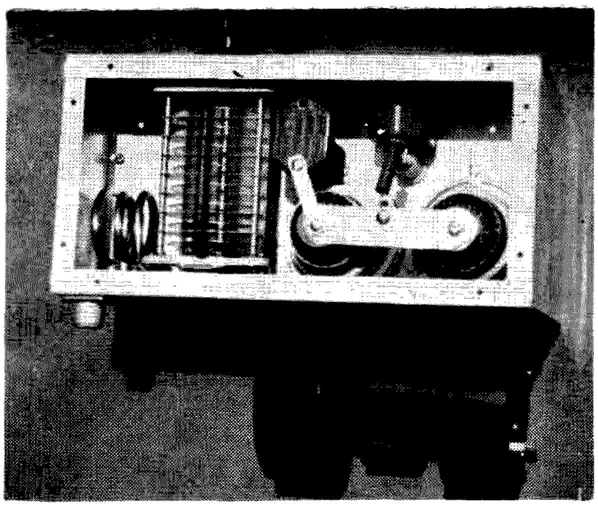
Described here is a really simple and compact six meter kilowatt amplifier. It is capable of one thousand watts on CW and SSB, and six hundred watts on AM, and a communicator will drive it into the *illegal region!*

Construction

The amplifier is built on a 5" x 10" x 3" aluminum chassis. Another chassis of the same size, with the bottom cut out, is used for the cover. It is best to choose a chassis that has a minimum of air holes at the corners and seam, since it will subtract from the amount of air available for cooling the tubes. Small bits of modeling clay can be used for plugging the holes or even airplane glue will work. The two 4X250B's are mounted along the left rear of the bottom chassis on a line that is 1½ inches from the rear and 1⅝ inches and 4½ inches respectively from the left side. These dimensions depend somewhat on the size of the variable capacitor you use. (The parts list is for non-bargain hunters.) Actually any capacitor will do that has a maximum value of fifty micro-microfarads and whose spacing will handle the rf voltage. The capacitor from a BC-375 tuning unit will work fine. The variable capacitor in the author's unit is mounted on a line 3⅛ inches from the right side and centered between the front and back of the top chassis. Leave at least 2½ inches between the right side of the tuning capacitor and the right side of the box for the plate coil. You will need room here to adjust the antenna tap to the right spot.

The author's amplifier fits nicely on the top of the Central Electronics 10A that drives it. Not much bigger than a VHF converter, it will fit almost anywhere in your operating area.

The feedthru insulator for the plate supply is placed approximately 2 inches toward the front of the amplifier from the line on which the sockets are mounted. It is equidistant from each socket. These are available in most surplus houses. The plate caps should be cut off between the second and third fins and the hole retapped for a 6/32 screw. The author found the use of these plate caps easiest for fastening the copper strap between the tubes and mounting the tab that supports the coupling capacitor. If you are unable to find the specified coupling capacitor, they can be obtained from L-R Electronics, Pasadena, California. Be sure to get the kind that have the bushings threaded for easiest mounting. The plate coil, as in most amplifiers, is a cut-and-try affair. Nearly anything from #10 copper buss wire to ¼ inch tubing will do for the plate coil. The unit shown uses 3/16 inch automobile gas line. Caution should be used in winding the coil out of this material since it will collapse if bent too sharply. A nice smooth coil can be would if the tubing is first filled with fine sand and the ends crimped closed. The handle of a medium sized screw driver makes a good form to produce the required diameter. Make the coil about 3½ turns to start and trim off as required to obtain resonance. Note the direction in which the coil is wound in the photo. The proper portion of the coil will be opposite the antenna connector if this winding direction is followed. Don't worry about duplicating the coil exactly since there is more

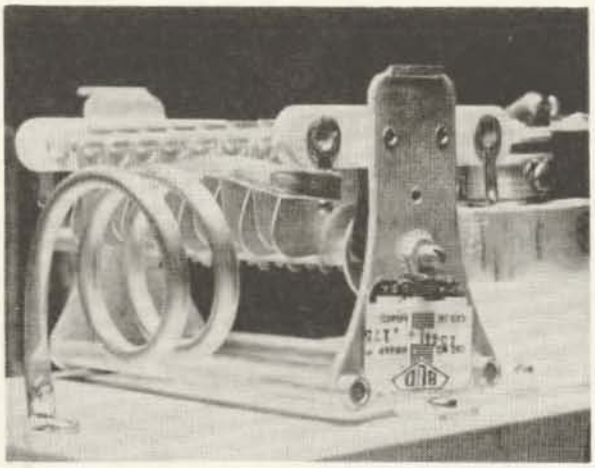


than enough capacity to make up for any loss in coil inductance if you happen to trim off a little too much. The author's units resonate with three, and two and a half turns respectively at about half capacity on the variable. There are a number of silver plating solutions that will increase efficiency slightly and give the coil a professional appearance. The other high voltage mica capacitor shown in the photographs is a bypass on the cold end of the plate choke, however it is only a refinement and is not needed for proper operation.

Under-chassis wiring is not critical and is left up to the discretion of the builder. It is advisable however, to keep the input capacitor leads as short as possible and not allow any components to block air flow from the blower.

Circuitry

The design represents probably the simplest circuit that is compatible with good performance. A passive grid circuit is employed since the idea was to build an amplifier with a minimum of parts yet obtain a superior quality signal on single sideband. The use of a passive grid circuit also eliminates the need for neutralization. The plate circuit is shunt fed so that no dc is on the tuned circuit, therefore the cold end of the plate coil may be grounded and the loading capacitor eliminated. This also permits closer spacing between the tuning capacitor plates. It is strongly recommended that the tube sockets be of the type with built-in screen bypass capacitors and grounded cathode pins. If you absolutely cannot get this type or have a garage full of the unbypassed kind, try at least .01 mfd to ground with the shortest possible leads. If the front end of your neighbor's TV set goes into orbit from one of your parasitics, don't say you weren't warned. The 20K resistor from the screen to ground is used to make the screen meter read upscale and will allow better observation of screen current fluctuations. After wiring, recheck for poor solder points and errors, it quite



Looking from the rear of the chassis, the plate coil is wound so that the part that is 1/2 to 3/4 of a turn from the ground end, is adjacent to the antenna connector.

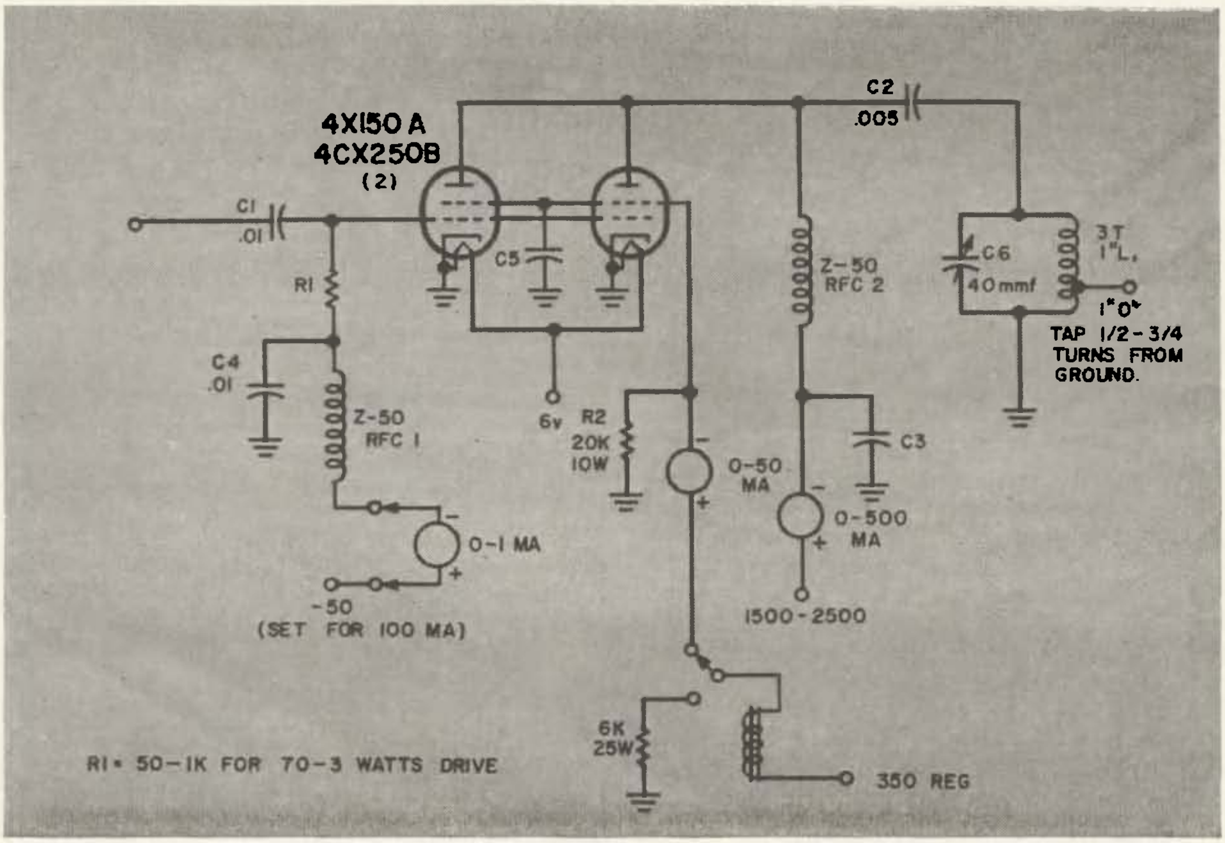
often pays off in a better unit.

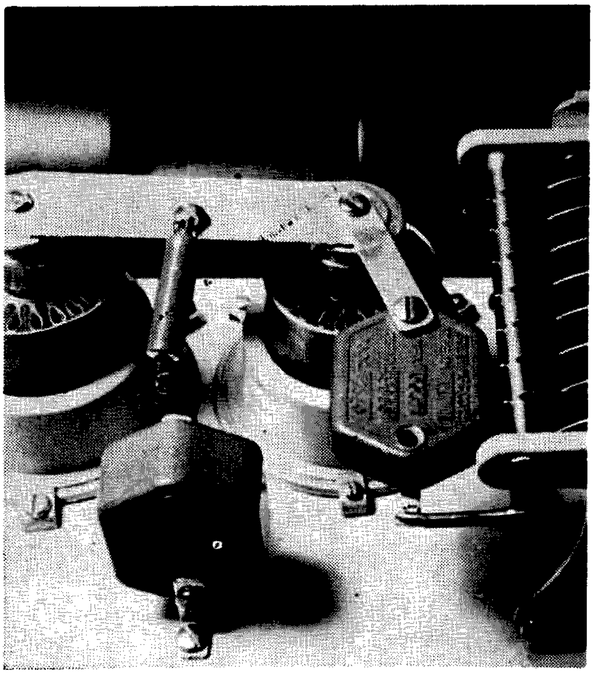
Adjustment Procedure
(CW and SSB modes)

The following adjustment procedure is for a plate voltage of 2000 volts and a screen voltage of 350 volts regulated. First set the bias for a resting plate current of 100 ma. This will mean about negative 50 volts or a little higher. Desired maximum values of plate, screen, and grid currents are as follows: Plate current, 500 ma., screen current, 50 ma. and grid current, O ma or a slight trace. Next connect the antenna or a suitable load to the output connector. Set the tap at ½ turn from the ground end of the plate coil. Now apply a small amount of drive from the exciter. As the drive is applied, the plate current will begin to rise. Immediately tune the plate circuit to resonance, as indicated by a dip in plate current. Continue to increase the drive, keeping a careful eye on the plate and screen currents. At this point it might be well to mention that with the value of 20K from the screen to ground, the no-drive screen current will be approximately 17 ma. As the drive is increased the screen current will probably go first below 17 ma and then will reverse and go above 17 ma. This is normal. If, as drive is increased, the screen current reaches 50 ma *before* grid current begins to show and the plate current reaches 500 ma. it is an indication of insufficient loading. If however the plate current exceeds 500 ma. before grid current shows, it indicated excessive loading. Adjust the antenna tap position to obtain 500 ma of plate current with just a trace of grid current. At this point the screen current will indicate somewhere between 17 and 50 ma. Under voice conditions, the screen current will kick around between 17 and 25 ma. The amplifier is now ready for operation on SSB and CW and will deliver approximately 600 watts output.

Adjustment for AM

If AM operation is desired, the amplifier should be adjusted as above. The drive is then





The plate coupling capacitor is supported by a heavy aluminum strap at one end, and a short length of copper tubing soldered to a lug, at the other. The plate bypass capacitor is mounted in front of the high voltage feed-thru insulator. Note positioning so that the choke leads can be short.

reduced until the plate current is about 275 ma. Modulation of the exciter will then be adjusted so that a trace of grid current is indicated on voice peaks. Plate current will remain constant if the amplifier is properly loaded. Output will be around 200 watts.

Screen Protection Circuit

In the interest of preserving the life of your tubes we present the simplest and most reliable screen protection circuits known (except perhaps for a fuse). Place a 50 ma. relay coil in series with its own normally closed contacts in the screen supply lead, with a 6K 25 watt resistor from the normally open contact to ground. If for any reason the screen current should rise above 50 ma, the relay will open and the 6K will hold it there until you can get things turned off.

Results

The unit is providing consistent and reliable communication on tropospheric scatter circuits from Los Angeles to Central California and the Bay Area. During the last VHF contest, 38 states were worked using the amplifier. Whatever mode of transmission you choose, you will be surprised with the performance obtained. The authors' are on single sideband, generally in the first 10 kc of the phone band. We'd be happy to QSO.

. . . K6QQN & W6QMN

Transistor Mike Preamp

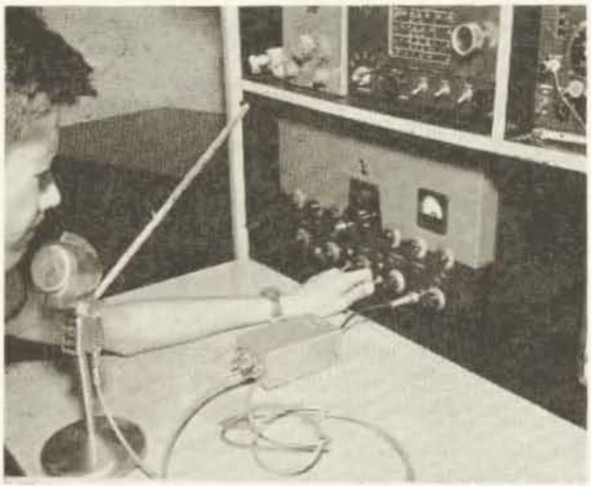
Glenn Malme, Jr., K6PZT
9337 Gotham Street
Downey, California

How many times have you wished that your transmitter might have just a bit more audio gain? Neither my Viking II nor my Gonset II had an overabundance of gain in the audio stages. Quite often, when conditions got rough, I found myself shouting into the mike in a subconscious effort to get more punch from the audio driver stages.

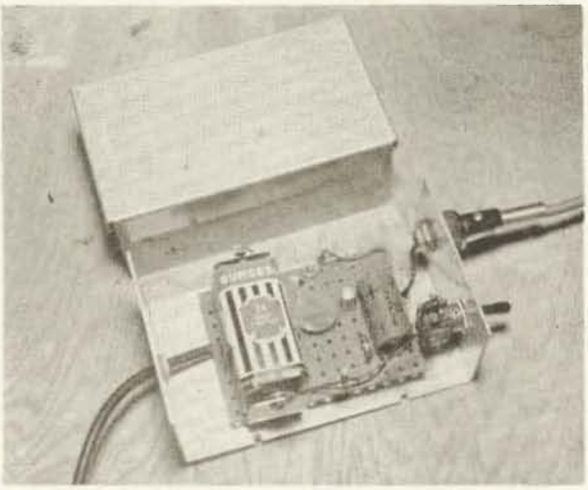
A transistorized preamplifier seemed like a good answer since there would be no power supply problems. The pre-amp shown here, which works extremely well with the Viking and Gonset equipment, evolved. An enterprising ham could repackage the unit to a smaller size, but this served my purpose quite well. Just a few dollars covers the cost of the parts.

Two such units have been built; one is used mobile on a Gonset two meter Communicator. On the air, test reports usually have evoked a "Wow! What a difference! How about sending me the diagram?" comment. It is used in conjunction with a dynamic mike. One resistor can be omitted if a crystal mike is used at the fixed station. It has put real life into the Viking II and now, talking in a normal or even hushed voice in the late hours of operation, still provides more than enough audio gain.

The CK722 transistor was selected because they are plentiful and cheap and do a more than adequate job. The fixed station unit was built into a standard 2" x 3" x 5" Mini-Box.



A toggle switch was mounted on the input side to cut off the six-volt battery required to operate the circuit. While the unit could be installed right at the mike, I left the mike cord unmodified and used a ten-inch length of shielded mike cord, found in the scrap box, for the output cord to the transmitter. The basic circuit is exceedingly simple, and the component values are not too critical.

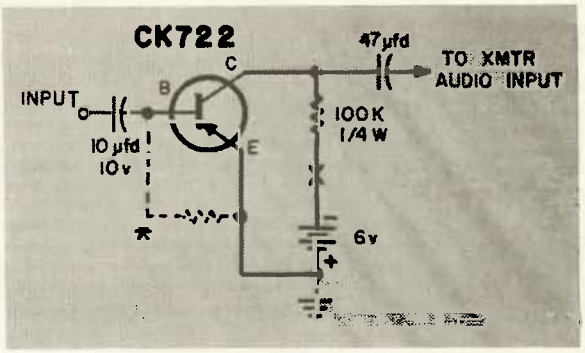


All parts were mounted on perforated mounting board cut to fit the inside of the Mini-Box, and a hole on each side was enlarged so that an 8/32 one-inch length bolt and nut serve as a standoff support. In operation you simply readjust your transmitter audio gain to suit your voice level. The metal box serves to shield the components quite satisfactorily; however, shielded mike cord for the input and output should be used. The unit can be built in less than an hour. Try it, and I'll bet that you too will say, "Wow! What a difference!" . . . K6PZT

Parts List

1—2 x 3 x 5 Mini-Box
2—Mike Jacks
1—.017 mfd 10 volt condensor
1—10 mfd 10 volt condensor
1—100,000 ohm ¼th watt resistor
1—47,000 ohm ¼th watt resistor
1—Z4 6 volt battery (Eveready)
1—Battery clip holder
1—CK722 transistor

(Note: 47,000 resistor required only if used with dynamic mike.)



*NOTE: Circuit shown for xtal mike for dynamic mike add a 47K ¼ watt resistor across the base and emitter terminals of CK722. Entire unit must be in shielded box.

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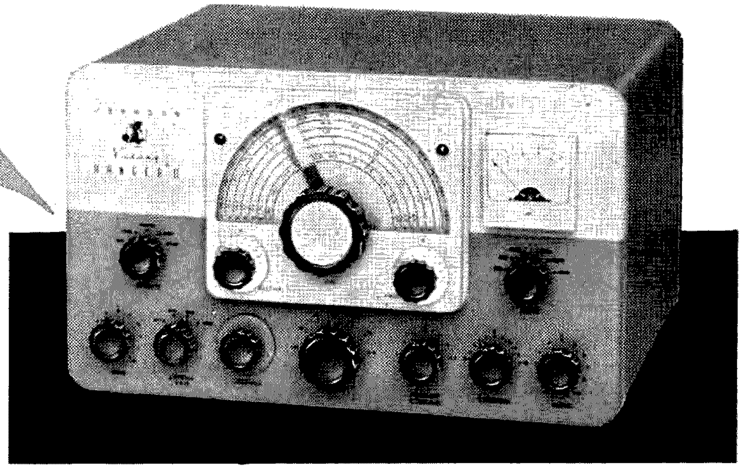
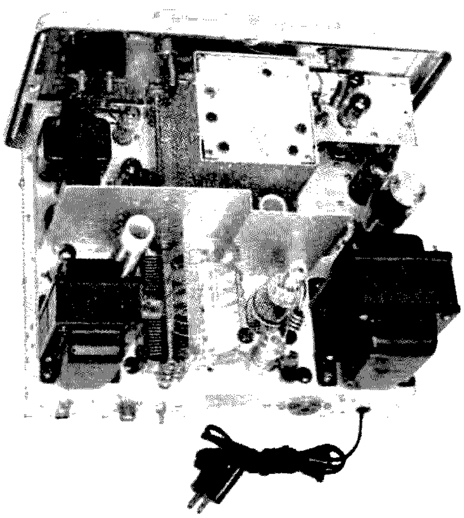


75 watts CW input ... 65 watts AM!



Now—a new version of the popular Viking "Ranger" . . . the "Ranger-II" Transmitter/Exciter! Completely self-contained in a handsome re-styled cabinet, the "Ranger II" now covers 6 meters! As a transmitter, the "Ranger II" is a rugged and compact 75 watt CW input or 65 watt phone unit. Pi-network coupling system will match antenna loads from 50 to 500 ohms and will tune out large amounts of reactance. Single-knob bandswitching on six amateur bands: 160, 80, 40, 20, 15, 10 and 6 meters—built-in VFO or crystal control. Timed sequence (grid block) keying provides ideal "make" or "break" on your keyed signal, yet the "break-in" advantages of a keyed VFO are retained.

As an exciter, the "Ranger II" will drive any of the popular kilowatt level tubes, provides a high quality speech driver system for high powered modulators. Control functions for the high powered stage may be handled right at the exciter—no modification required to shift from transmitter to exciter operation. Nine pin receptacle at the rear brings out TVI filtered control and audio leads for exciter operation. This receptacle also permits the "Ranger II" to be used as a filament and plate power source, and also as a modulator for auxiliary equipment such as the Viking "6N2" VHF transmitter. Unit is effectively TVI suppressed . . . extremely stable, temperature compensated built-in VFO gives you exceptional tuning accuracy and velvet smooth control. Complete with tubes, less crystals, key and microphone.

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Transistor Two-Tone RTTY Oscillator

J. R. "Bob" Barbay W5SFT
6811 Tolland Street
Dallas 27, Texas

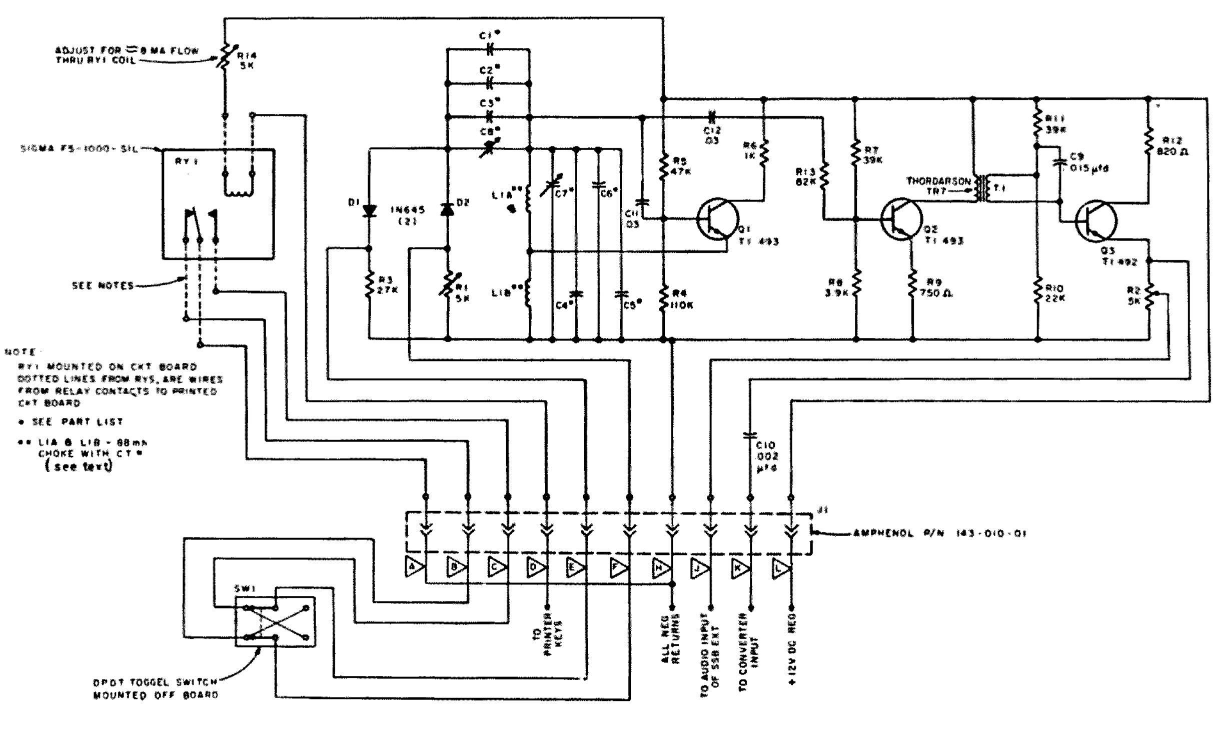
FOR this issue, we have a little more for the RTTY fan, a "two-tone" oscillator on a printed circuit board. This oscillator has some of the same design characteristics of other oscillators described in the RTTY handbook except that transistors are used rather than vacuum tubes. The oscillator discussed here can be keyed on either mark or space pulses.

AFSK operation requires a reasonably stable audio oscillator that will supply standard tones of 2975 cycles for space and 2125 cycles for mark when keyed from the keyboard of the teleprinter. The two output tones are simply fed into the input of a modulator or into an SSB exciter which has very good unwanted sideband and carrier suppression.

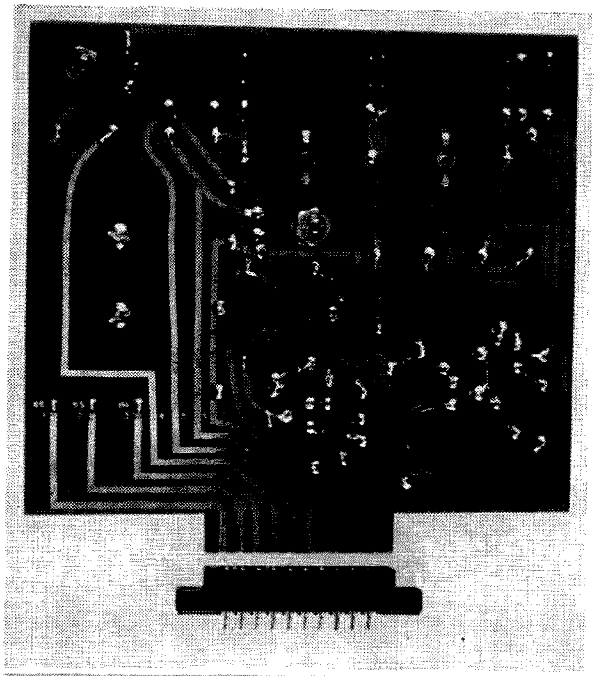
Transistor Q1 is the oscillator. The oscillator inductor is an 88 mhy toroid type telephone loading coil. This inductor is noted on the schematic as L1—a and L1—b. Notice that capacitors C1 through C8 are utilized for tuning the oscillator and should be high-grade mylar, paper or mica. *Do not use disc ceramic types.* When adjusting the oscillator frequency, be sure the entire circuit is complete and the keyboard is connected in the circuit. Tune the space frequency (2975 cps) with the keyboard circuit open. Tune the mark frequency (2125 cps) with the keyboard circuit closed.

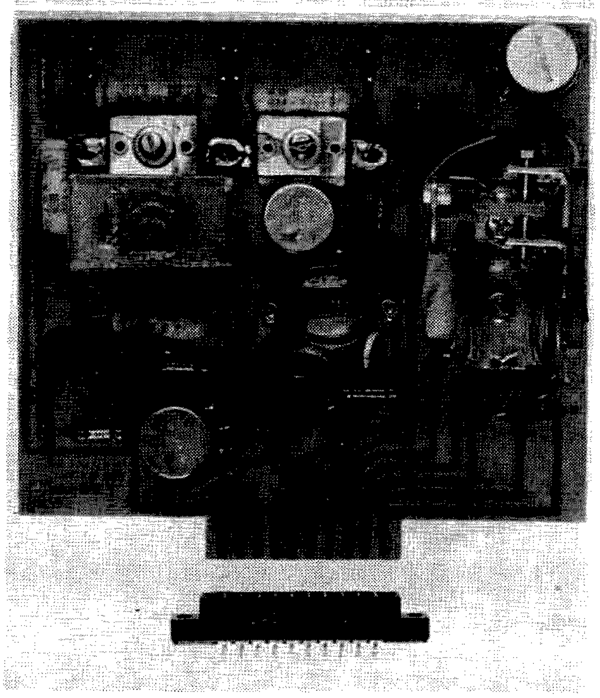
Circuit Description

The output from the oscillator, Q1, is RC coupled to the base (input) of Q2, which serves



TWO TONE OSCILLATOR FOR RTTY (2125 & 2975 cps) WITH KEYING RELAY FOR MARK OR SPACE





as both an amplifier and isolating stage. The output of Q2 is coupled through an interstage transformer to the base (input) of emitter follower Q3. From the output stage, Q3, the audio tones are fed into the converter, for local copy, and into the modulator or SSB exciter. Converter input is taken directly from the emitter of Q3, while the output level for the transmitter, may be adjusted and is coupled out from the arm of the emitter load resistor, R2.

Construction

The two-tone oscillator is quite simple to construct on the printed circuit board available from Tri-Tronics Lab. Inc. Only a small

drill, small soldering iron and simple hand tools are needed. Provisions are made to mate the printed circuit board with an Amphenol P/N 143-010-01 connector for plugin use, or the circuit board may be wired directly into associated equipment.

Adjustment

The relay (Sigma F5-1000-SIL) is set for a pull-in current of approximately 8 ma. However, other relays with equal coil values may be used in this circuit. Relay current is adjusted by potentiometer R14. This adjustment is made by breaking the circuit between R14 and one side of the relay coil and inserting an appropriate meter.

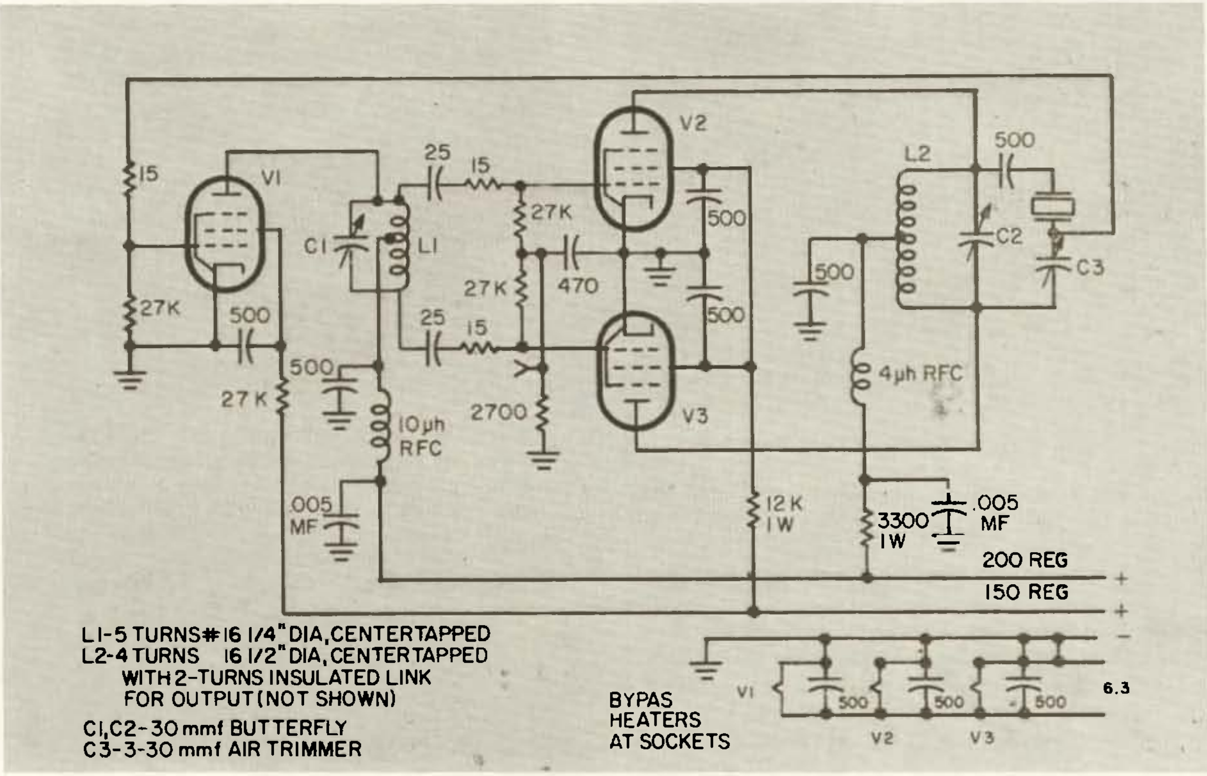
Oscillator output level is adjusted to obtain equal output amplitude for both tones. This is done by keying the printer and adjusting R1 until there is no difference in the transmitter plate current readings during mark and space times. When this adjustment is completed, tone output of the transmitter will be equal for both mark and space.

Conclusion

All parts listed for this project may be purchased from your local distributor. However, a well stocked junk box should produce most of the parts required to complete this circuit. The 88 mhy coil can be obtained from sources listed in the RTTY handbook or from Irving Electronics, Box 9222, San Antonio 4, Texas. The printed circuit board is available from Tri-Tronics Lab. Inc., Box 238, Euless, Texas, (Price $2.00 P.P.) and the transistors are available from any Texas Instruments Incorporated authorized distributor. It would be advisable to check surplus ads to find the required relay as many of this type can be found from surplus houses. . . . W5SFT

Parts List

All resistors ½ watt
All condensers 100 volts
C1, 2, 3 plus C8 equal approx. .0398 mfd (2125 cps tone)
C4, 5, 6 plus C7 equal approx. .0347 mfd (2975 cps tone)
L1A-L1B—see text



ADDENDUM FOR CRYSTAL OSCILLATORS

Please substitute the following diagram for the one marked (in error) as Figure 12 in the September issue, page 57. We have various lame excuses for this. At any rate we are maintaining our inadvertent policy of publishing all articles in three parts: the original article, the corrections, and the corrections on the corrections. This sort of lends a nice feeling of continuity to the magazine, don't you think?

Now, about this oscillator. This is a capacitance-bridge oscillator and it is capable of giving you the 73rd harmonic of a crystal, putting you on 219 mc with a 3 mc crystal! This should be great for a 220 mc converter.

D. L. Heller K3HNP
14 Darkleaf Lane
Levittown, Pennsylvania

Have you met these Characters?

These incidents in the work of a TVI committee are the calls we talk about. The majority of our complaints are bona-fide; most of the complainants are polite and reasonable, and their troubles are always (almost) completely cleared. The committee serves a useful purpose both for the amateur and his TV listeners. But have you met—

He quite indignantly insisted that K3—be kept off channel 8. I had no trouble convincing him the nearest channel 8 was several hundred miles away and hadn't yet been reported Q5—he knew that. But he was sure the ham had no right to be there calling CQ 20. I couldn't quite understand what he expected.

She reported excellent reception of W3—next door, which she couldn't understand since "I only have an indoor antenna."

She was happy to have the committee visit her, for the amateur interference was "quite upsetting" according to her letter. But a check of the TV showed no interception at all. Nor did the radio or phono. "What is the trouble?" I asked again.

"He's always on my telephone."

"The telephone company will clear it up—for free, no less."

"But you don't understand," she continued, almost crying. "I can't hear the one he's talking to."

The follow-up of a petition is often an unusual experience. One of these involved a six-meter operator running close to a half gallon—of course his own TV was clean, but we expected technical problems. We had none—just characters. But we were forewarned. The petition as sent back from FCC had several dozen signatures, but involved only eight TV sets.

A typical call was that at Mr. M's house. The check of the TV showed absolutely no amateur pickup even with the set detuned. I pointed this out to Mr. M. and asked when he had trouble.

"Three in the morning."

"He's running full power now, and we see no sign of him on the set."

"He runs more power at three in the morning."

"That's impossible," I had to say.

"How much can he run? I heard he's running 20 amps."

"Legally he can run 1000 watts. But his equipment can't go much over 300."

"I think he runs 1025 watts at 3 in the morning."

"When did you last hear him?"

"This is a whitewash. Last week." (his AF gain up a bit.)

"When was your TV last repaired?"

"This is a whitewash. Six months ago" (add 3 db audio.)

This continued a bit—he finally admitted having had no trouble since his set was fixed many months back. AF gain slowly advancing. I then asked why he had signed a false statement and submitted it to FCC—a government agency. Response was confused—the volume was up past the distortion point. On the report form I had a brief transcript of our conversation, and my findings, and at the bottom, "FRAUDULENT." I showed him the report and invited his signature. "I'm a businessman. I don't sign anything." As I left he was still yelling "whitewash."

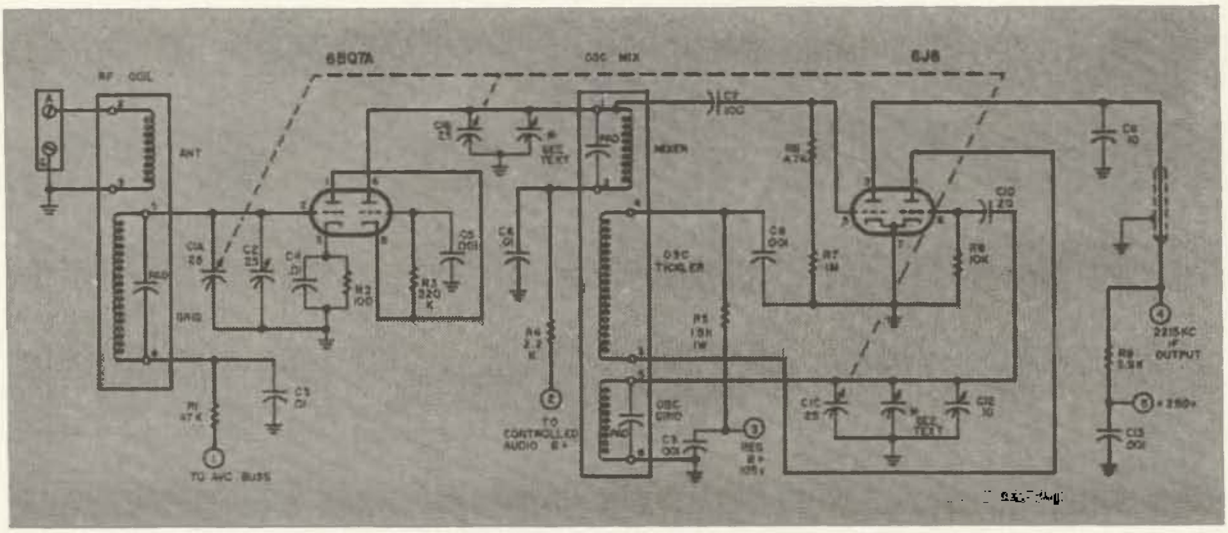
Then there was the case of Mrs. B. A severe case of TVI had been traced to an appliance in her house; since she was unwilling to repair it on her own, in due course she got a note from FCC. Unfortunately her TV was as sick as the appliance and the amateur who had traced the trouble was in on all channels. She refused to get a filter or to do anything but phone and complain. Finally she was insistent on relief for a special program—request denied. So she called FCC and gave them hell. Within several days an FCC engineer had visited the amateur and found him clean. He then went to Mrs. B., who was very pleased to see him—until he told her she should fix her TV. Then she had unkind words for him. The problem was compounded by the instructions regarding her TVI appliance: fix it, license it, or get it off the air.

Much of our trouble is caused by misinformed servicemen. A typical case was caused by one of the largest service organizations. A Drake filter was properly plugged into the set, but the filter was still ineffective. The recheck showed that the filter was grounded with a steel spring extending the width of the set. Perhaps the dc resistance was low, but the rf impedance of this several hundred turn coil figured to be several thousand ohms.

. . . K3HNP

T.V. Special Receiver

Louis Hutton WØRQF
2608 South Fern
Wichita 17, Kansas



THE equipment described in this article is a restricted coverage amateur communication receiver. It features 2.8 kc bandwidth, AM and SSB detectors, crystal controlled BFO, and S-Meter. Up to 12 individual frequency bands may be selected in the 3.5 to 60 mc range. The receiver's over-all performance is comparable to commercial products in the 150 dollar class, but will cost the constructor from one half to one third less, depending on the contents of the "junk-box."

I decided to build a receiver after having some sad experience with portable operation using a commercial ac-dc "communications" receiver. The decision to try my hand at receiver construction came when I listened to the home constructed receiver built by KøLZU. His receiver is a copy of the unit described on Page 540 of the Radio Handbook, 15th edition. My receiver is designed around that unit but is modified to fit my requirements and parts supply.

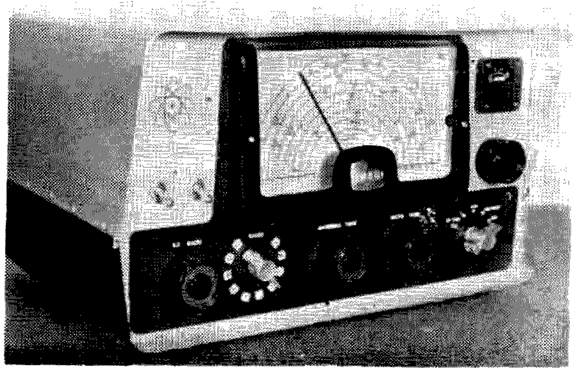
Tuner Modification

The surplus TV tuner used for the front end in this receiver is a *Standard Coil* cascode type removed from an old 1953 model Majestic TV. All of the wiring except the heater circuit was removed. The 21 mc *if* coil was discarded and the mounting tab hammered back flush with the chassis. New condensers and resistors were purchased and the tuner chassis was rewired as shown in the diagram. I removed the

Tuner

BAND	WIRE	ANT	GRID	PAD	MIXER	PAD	OSC TICKLER	OSC GRID	PAD
WWV	22	11T	34T	68mmf	21T	90mmf	12T	20T	50mmf NPO
80A	24	27T	90T	75mmf	60T	75mmf	30T	60T	50mmf NPO
80B	24	27T	90T	100mmf	60T	180mmf	30T	60T	56mmf NPO
40	22	17T	45T	33mmf	40T	75mmf	15T	26T	82mmf NPO
20	22	7T	19T	50mmf	25T	50mmf	9T	15T	82mmf NPO
15	22	7T	11T	50mmf	13T	47mmf	7T	10T	100mmf SM
CB	22	8T	10T	50mmf	17T	10mmf	11T	8T	100mmf SM
10	22	6T	8T	20mmf	8T	56mmf	8T	10T	25mmf NPO

Coil Table. All wire enameled and close spaced. Mixer padders either disc ceramic or silver mica, all other padders disc ceramic.



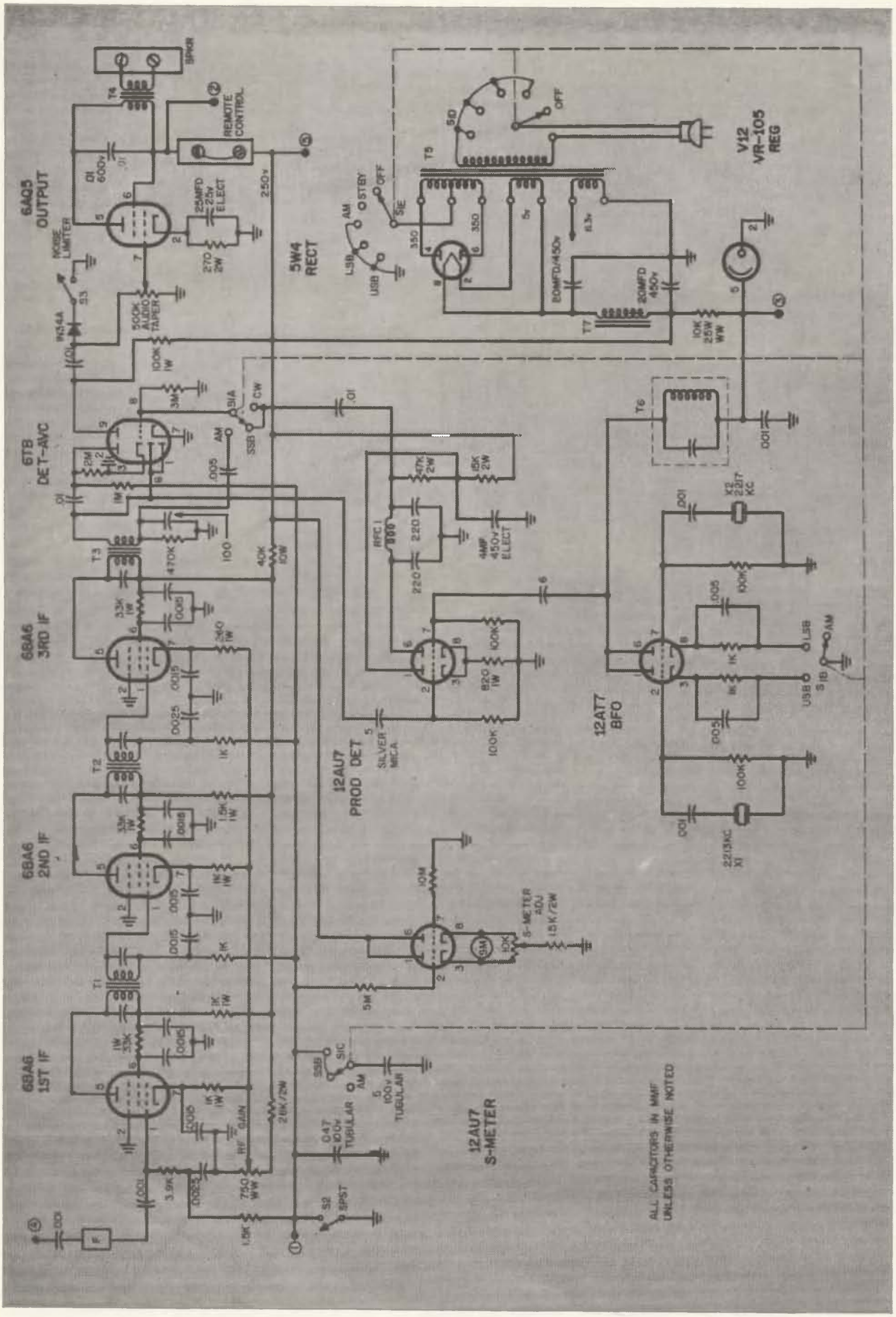
metal side cover plate, fine tuning control and capacitor. The coils and the fibre coil forms were removed from the clip-in coil strips. Coils were rewound as listed in the coil table.

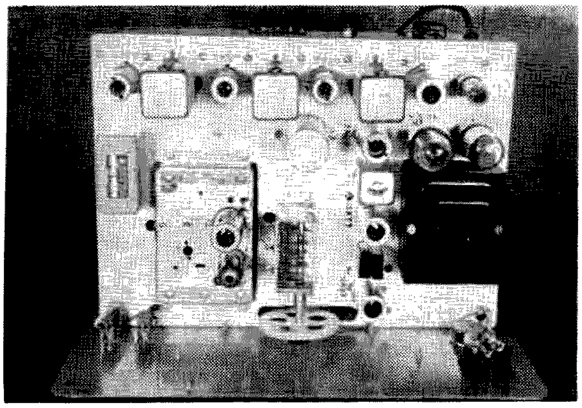
Construction

The major components were laid out on the 11 by 14 by 3 inch chassis as shown in the photograph. Since my operation is predominantly AM and SSB, I used the 2215 kc crystal lattice *if* filter (2.8 kc bandwidth) made by *Hermes*. The receiver made by KØLZU used a homemade filter at a much lower frequency (455 kc). His receiver was dual conversion, whereas mine is single conversion. The *if* transformers are designed for 1650 kc *if* operation, but I modified them to 2215 kc by replacing the padder condensers across the coils with 20 mmfd silver mica condensers. After the major components were mounted the tube heaters were wired and power applied to make sure of no errors or omissions. The power supply and audio circuits were wired and given a quick check by connecting the output from an audio signal generator to the grid of the triode section of the 6T8.

The *if* stages, AVC detector, noise limiter and the AM detector circuits were then wired. A 2215 kc rf signal was fed to the input of the filter to align the *if* stages. The *if* stages promptly broke into oscillation and no amount of stagger tuning or cathode resistor value juggling would completely cure the trouble. I finally traced it to the noise limiter wire which was routed too near the plate and grid circuits of the *if* strip. This wire was rerouted away from the *if* circuitry and the feedback stopped. The S-meter circuit wiring was completed and connected to the AVC buss. The original 1.25 millampere meter was replaced by a 500 microampere unit to provide for a greater swing to the S-meter indicator on weak signals. The meter was carefully removed from its case, and the lettering blanked out with black dope. Decals were used to mark the new calibrations, converting it to an S-meter.

The product detector and crystal controlled BFO circuit were wired next, and each BFO crystal frequency was adjusted to the proper

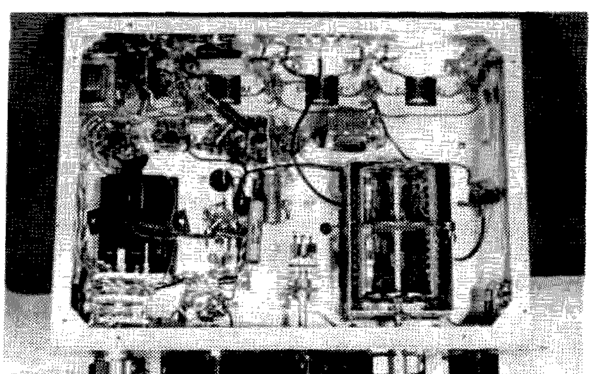

6BA6
1ST IF
6BA6
2ND IF
6BA6
3RD IF
6T8
DET-AVC
6AQ5
OUTPUT
5W4
RECT
12AU7
PROD DET
12AT7
BFO
12AU7
S-METER
V12
VR-105
REG
ALL CAPACITORS IN MMF
UNLESS OTHERWISE NOTED



point on either side of the bandpass of the *if* filter. One crystal appeared to be on frequency, but the other required a small amount of capacitive padding to bring it on frequency. The tuner sub-chassis was now connected to the *if*, AVC, and power supply circuitry. Now begins the most trying part of building a receiver of this type, the front end alignment.

Tuner Adjustment

Whereas most modern communication receivers provide for coil frequency adjustment by padding and trimming condenser on slugs, this tuner is adjusted by removing turns from the coil or by squeezing or spreading the coils. The grid dipper is used to check the rf coil frequency. Sufficient turns are supplied on the coil so that resonance at the desired frequency is found with the antenna trimmer half meshed.



The oscillator tickler winding is wound in reverse rotation to the oscillator grid coil so that it will oscillate.

The coil and tuning condenser combination that I used requires two coil banks to cover the 75 meter phone band. Only the phone portion of 40, 20, 15 and 10 meters are covered in this receiver. The entire 11 meter citizens' band and the 10 MC WWV bands are provided on two more coil strips.

Cabinet

The cabinet is formed from two pieces of aluminum. The bottom half is painted a dull black,

and the top half silver grey hammertone. A chrome trim strip salvaged from the dash of a 56 Buick was used to cover the joint where the two pieces were joined. Sheet metal screws through rubber feet are used to hold the chassis in the cabinet. The dial scale was calibrated on a piece of white cardboard, then redrawn in twice size. This was photographed and enlarged to full size. The dial cover was swapped from another amateur and was originally part of a two meter Geloso VFO dial assembly. A speaker assembly was manufactured from a dime store plastic flower pot.

Connections are provided in the rear of the chassis for the speaker, and remote control of the receiver B plus. The S-meter adjustment is also located on the rear apron.

. . . WøRQF

Parts List

T1-3—1650 kc if transformers modified to 2215 kc as in text. 912-W1, W2, W3.
T4—Stancor A3877 (5000 to 4 ohms).
T5—Stancor PM8409 (700 vct/90 ma; 5v/2A; 6.3v/3A).
T6—Miller 012-W1.
T7—Stancor C1709 (8 Hy - 85 ma).
F—2215 kc filter; HERMES ELECTRONICS CO., 75 Cambridge Pkwy, Cambridge, Mass.
S-meter—500 microamp; Burstein-Applebee 18A916.

Jim Kyle K5JKX/6
1851 Stanford Avenue
Santa Susana, California

Solid Power, OM!

WE'VE said it so often, it's hardly wort while to say again that semiconductors are here to stay. And it's no news that one of the most obvious applications of semiconductors in a ham rig is in the power-supply department. Therefore, we won't give you any sales pitch for siliconizing your power supply except to point out that solid-state rectifiers run cooler, last longer, take up less space, and in the long run cost less than do their vacuum-tube counterparts.

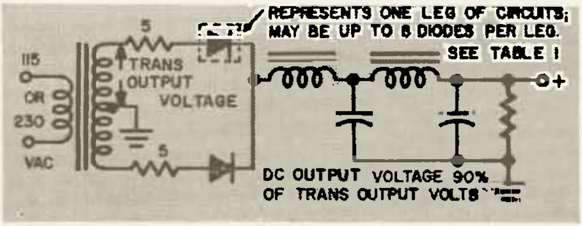
Designing (or haywiring, whichever term you prefer) a low- or medium-voltage power supply around silicon rectifiers is a pretty simple affair; however, when you get into the neighborhood of 100 watts' worth or so the job can get rather hairy, since unlike the vacuum tube the silicon rectifier is a bit weak in the department of reverse voltage. The kind you're most likely to find at the corner parts emporium is rated to take only about 130 volts of ac, which isnt' much help when you want 750 volts dc output.

Connecting a number of the little gems in series easily overcomes the reverse-voltage problem. Just one small question arises then—and confusion reigns around the answer. That question is: "How many in series for what voltages?"

MANUFACTURER	PEAK INVERSE VOLTAGE RATINGS 400	500	600	800	1000
Amperex	OA210	—	—	—	—
Diodes, Inc.	DI -54	—	DI -56	DI- 58	DI -510
General Electric	1N604	1N605	1N606	1N560	1N561
Mallory	1N2094/T400	1N2095/T500	—	—	—
Motorola	1N540	1N1095	1N1096	—	—
Raytheon	1N540	1N1095	1N547	—	—
Sarkes-Tarzian	M-500	50M	60M	—	—
Sylvania	SR-500	—	—	—	—

Table II. Type Numbers VS P.I.V. ratings for readily available 500-750 ma diodes.

You can write the manufacturer (tell them you saw it in 73) but if you write to more than one at a time you'll discover, as we did, that each manufacturer inserts a different safety factor in his ratings. The result will be that you still won't know how many diodes to hook together for your 2500-volt supply.



We've compiled a chart listing the number of diodes needed, according to various voltage ratings, for a number of commonly used transformer voltages; a companion chart translates the PIV ratings back to diode type numbers to make it easy to obtain the proper diode. But before we explain the chart, let's look at the two circuits most used for medium- to high-power supplies: The full-wave center-tapped, and the bridge.

The full-wave center-tapped circuit, shown in Fig. 1, is the conventional vacuum-tube power supply circuit. If this is the circuit you're going to use, measure the output voltage of the transformer from one side of the high-voltage winding to the center tap, and read the "full-wave" column of our chart.

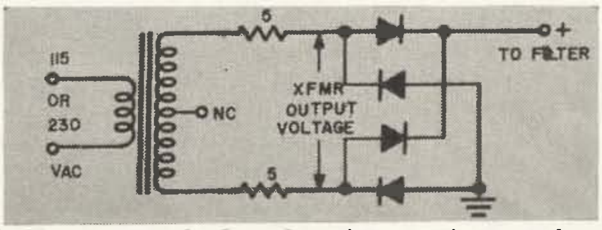
The bridge circuit of Fig. 2 isn't so common with vacuum tubes, since supplying filament current for all the rectifiers poses a problem. However, with semiconductor rectifiers the filament-power problem disappears, and the bridge circuit becomes more attractive because it allows approximately double the output

Transformer Output Voltage	FULL WAVE CIRCUIT PIV rating of each diode	Number per leg	BRIDGE CIRCUIT PIV rating of each diode	Number per leg
130	400	1		
260	800	1	400	1
260	400	2		
375	600	2	600	1
375	400	3		
520	800	2	800	1
520	400	4	400	2
650	1000	2	1000	1
650	500	4	500	2
650	400	5		
750	600	4	600	2
750			400	3
975	1000	3	500	3
975	600	5		
1040	800	4	800	2
1040			400	4
1300	1000	4	1000	2
1300	800	5	500	4
1300			400	5
1500	1000	5	800	3
1500			600	4
1950	1000	6	1000	3
1950			600	5
2600	1000	8	1000	4
2600			800	5

TABLE I. Number of diodes required per leg.

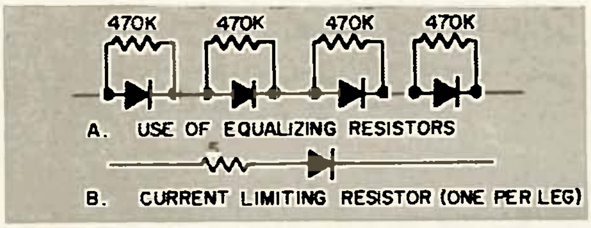
voltage from the same transformer. For the bridge circuit, measure the transformer output voltage across the full high-voltage winding, and read the "bridge" column of our chart.

You'll note that the rectifiers are apparently able to stand twice the voltage in the bridge circuit that they can handle in the full-wave circuit. This happens because, in the bridge circuit, two of the four bridge legs are always in a series at any instant. You'll also note that, for the same transformer voltage, the same *total* number of diodes are used with either circuit. While the bridge circuit requires only



half as many diodes of a given rating per leg, the bridge circuit contains four legs while the full-wave circuit has only two. Therefore, the transformer output voltage should be the deciding factor in choosing the circuit.

Semiconductor rectifiers are unlike vacuum tubes in another way, too; they can't stand much overload. The voltage ratings given in our chart include a 10 percent safety factor to allow for line voltage surges; if possible, you should increase this safety factor by designing for a voltage slightly higher than that actually present. If you need the figures for a voltage not included on the chart, you can calculate it easily. First multiply the transformer output voltage by 3.08 (for the full-wave circuit) or 1.54 (for the bridge circuit) to find the total PIV rating you must have. Then divide this figure by the PIV rating of the diode type you intend to use. Naturally, the answer must



be rounded off to the next higher digit—where are you going to get half a diode? For instance, a 1500-volt transformer voltage would require a total PIV rating of 4620. Using 1000-PIV rated diodes, we get 4.26 as the answer. Our chart lists 5 diodes.

To make sure that the voltage divides properly between the various diodes in the string, connect equalizing resistors in parallel with the diodes as shown in Fig. 3A. The high-valued resistors won't degrade diode performance, but they will make certain that no individual diode is overloaded due to failure of the voltage to divide properly down the string. Omission of these resistors has caused failure of a number of experimental power supplies.

The final point has been said so often it seems almost unnecessary, but forgetting it can also cause monetary grief (32 diodes represent nearly a third of a centibuck, anytime!). That is that a semiconductor diode must have a current-limiting resistor in series with it as shown in Fig. 3B. The value of this resistor need not be over 5 ohms, and a 2-watt 4.7-ohm unit will do the job nicely. Its function is to protect the rectifier against over-current in case the supply is switched on when the AC voltage is at its positive peak and the filter capacitors are discharged. Under these conditions, the entire power-supply circuit looks like a dead short across the line, and the diode plays the role of a fuse (the fuse itself won't blow out in 1/120 second, but the diodes will in considerably less time than that).

Letters

Simple as A-B-C1

Dear Editor:

The thought provoking discussion of classes of amplifiers in your August issue has indeed provoked me —according to information in one statement in the discussion, my mobile rig has been operating in a "self-contradictory" mode for the last year!

The statement I take exception to is ". . . a class C1 amplifier is self-contradictory; to operate class C, grid current must flow." Frankly, I find this statement 'self-contradictory.' To explain. . . .

Author Kyle correctly identified the class C mode as that mode where plate current flow occurs in less than half the cycle. However, it is not necessary for grid current to flow in order that plate current flows. For example, a tube could be biased at, say, 30 volts beyond plate current cut-off, cut-off bias being, say, —50 volts. Thus, the d-c bias is —80 volts. Any signal having a peak swing of more than 30 volts would cause the tube to conduct plate current for that time in the cycle where the signal voltage overcame the cut-off level.

Admittedly, most power tubes won't operate very efficiently or near their power capabilities with such slight excitation. However, some modern beam pentodes have so high a gm that they exceed their d-c plate power ratings at zero bias. There is no need to drive such a tube into the positive grid current region, thus consuming driving power.

To be sure, my 5 band 400 watt carrier-control mobile rig could not have been built into its 5" x 6" x 9" enclosure without the feature of class C1 operation of the two 6DQ5's in the final; with negligible drive requirements the VFO-exciter was reduced to a two tube affair.

I hope that these comments will save the class C1 mode from an undeserved fate of 'self-contradiction'!

John Dannenberg W6HBF

You're right, now how about an article on that rig?

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Dear Big Daddy:

Well, it's a wonder some cat hasn't come up with a real crazy answer to this license fee bit. So here's my monumental answer to a lot of things—this will really solve the whole problem:

C. B.	$5 per application and renewal
Novice	$5 per application
Technician	$3 per application and renewal
General, Advanced, etc.	$1 per application and renewal
Extra Class	$1 per application
Ladies	Free, God Bless 'em.

Can you think of a better incentive for Novices and Techs to bone up for the General exam? And assuming 300,000 amateur licensees in the near future, 300 KBUCKS should fill the pot nicely down there in Direct Current Land. Like, man, this plan is way out! Like, man, cats with 365 DX contacts per year entitled to 3% reduction in fees upon submission of QSL's. Like, additional 1% reduction for cats with cool homebrew linears. Man! Like, end of fiscal year surplus to be used for Giant Bang and Smash Hamfest and Surplus Prize Drawing. Yeh!

I realize it takes really brilliant people like you and me with the crystal clear keen perceptability to reach the logical solutions unattainable by those W3-clods; and opposition will rear its ugly head supported by the dunces of the rest of this stupid world who are too cheap to contribute to the support and furtherance of the glorious hobby of Amateur Radio and 73 Rag. Let's face it. You and I are in the minority, and I have the greatest respect and admiration for you.

Please excuse the crayon—they don't let me have anything sharp here.

Lou W3DVB

Dear Wayne,

I read with interest the article on "Zero Shift Keying" by Jim Kyle in the September, 1961 issue of "73." Both you and Jim should be complimented on bringing to the attention of the amateur fraternity new techniques which can be tried and evaluated by interested experimenters.

Perhaps a few footnotes to Jim's article, elaborating on some of the characteristics of zero shift keying might be of interest to your readers.

The modulation scheme described in the article is a type of phase modulation. It is sometimes referred to as 180° phase shift modulation and has been used in various commercial and military communication systems. Considering first the bandwidth requirements, it should be noted that this type of keying, when the bits have a nominal length of 20 milliseconds, will produce side bands every 25 cycles from the original carrier frequency. For any intelligence to be transmitted, at least the first pair of side bands must be transmitted and for good keying characteristics the first and third side bands should be transmitted. This means that for the example chosen, a minimum bandwidth of 150 cycles per second would be required. As the author points out, the 850 cycle frequency shift is a legacy from land line work and creates an artificially broad channel requirement when applied to RTTY work. The 180° phase shift type of modulation should, therefore, be referred to as a minimum bandwidth system. The concept of zero frequency shift is not truly accurate. It is, further, interesting to note that when equal numbers of marks and spaces are being sent, the actual power transmitted on the original carrier frequency is zero—all power appearing in the generated side bands.

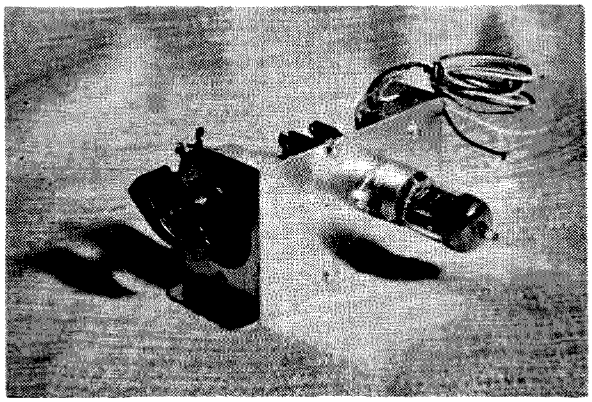
Inasmuch as the modulation scheme results in minimum occupied bandwidth, it should not be difficult to obtain an interpretation or ruling from the FCC to permit amateur use of this technique in any of the bands currently allocated to CW or RTTY work.

The technique of 180° phase shift keying relieves the user of the requirement of re-establishing the two audio tones required in the standard RTTY used by amateurs at the present time. This is, as Jim points out, probably its chief advantage. Its chief disadvantage was apparently overlooked in the original article, however. If a CW signal is transmitted on an HF band by reflection from the ionosphere, quite commonly more than one transmission path will exist between transmitter and receiver. Under such conditions, multipath fading will occur. It is characteristic of multipath fading that frequent 180° reversals of phase will occur in the carrier during the fading periods. If a phase reference is generated at the receiver as suggested in the article, and adjusted to give the proper mark and space sequence at any given instant, the spaces and marks may be reversed a short time later due to this fading phenomenon. There are many ways of meeting this problem; the most common being to associate a mark with a change of phase between two successive bits and a space with the absence of a change of phase between two successive bits. If this is done, only one bit is lost when propagation causes a 180° phase reversal of the signal. This technique will, of course, slightly complicate the circuitry required, but still does not produce a particularly complicated system.

Another type of keying which should be called to the attention of an amateur interested in improved radio teletype systems, is the baud synchronous system. This scheme, sometimes referred to as "integrate and dump" or "predicted wave signalling" goes even farther than phase reversal keying and nearly approaches maximum information transfer in minimum bandwidth. Systems have been built in which up to 40 teletype channels have been compressed into a single 3 kc bandwidth.

This system has been incorporated by the Collins Radio Company into its Kineplex data system and by other groups into various commercial and military systems. A description of this system was given in the book, "Fundamentals of Single Side Band" published by the Collins Radio Company, Cedar Rapids, Iowa.

Jim Green K5WUT



Jim Kyle K5JKX/6
1851 Stanford Ave.
Santa Susana, Calif.

Phasing for Audio Selectivity

RALLY round, those of you who have tried and abandoned range filters, resonant audio circuits, and all the other conventional methods of obtaining narrow-band audio selectivity for CW operation.

Here's a gadget based on a little-known approach to filter theory which can make the 80-meter Novice band sound as vacant as the lower end of the 3500 mc region—yet won't smash your pocketbook or your patience to build.

Most CW operators agree that something is needed to weed out the other 437 signals from the passband of the receiver, and many of us have settled on some form of audio filter. One of the most popular is the surplus range filter, with a 1020-cycle center frequency.

However, after an extended period of listening, it's hard to tell if a signal is there or not—the note seems to persist, even with the receiver turned off!

This gadget avoids that, by allowing you to choose the center frequency you want—50 cycles (as some veteran CW men prefer) or 5000 cycles, it's all the same to the filter. Only three capacitors must be changed to vary the frequency at any time.

Here are the complete specifications:

Passband at 6 db point: Continually adjustable from 10 cps to more than 5 kc while in operation.

Center Frequency: chosen by constructor; can be changed at will.

Rejection outside passband: Continually adjustable from approximately 50 db to ø db by selectivity control.

Maximum input: approximately 1 volt rms.

Output at maximum selectivity: approximately 10 volts rms.

Cost if all parts purchased new: approximately $5.

Time to build: approximately 45 minutes.

Time to place in operation after completion: approximately 90 seconds.

Interested? Let's look at how it works first, then get to the construction and hookup details.

While most audio filters of the bandpass variety (which is the only kind we're interested in at the moment) are based on resonant circuits, this one works on the phase-shift principle.

As you know, an ordinary vacuum-tube amplifier shifts the phase of the signal 180 degrees between grid and plate circuits.

As you probably also know, an RC-network will shift the phase of any signal applied to it.

Three RC networks connected in cascade can be made to shift the phase anywhere between almost zero degrees and almost 270 degrees between input and output, depending on the frequency and the values of R and C employed.

For any given values of R and C, at some point in the frequency spectrum the phase shift through the triple network will be 180 degrees. To determine the exact frequency for any values of R and C, use this formula: $R \times C \times F = 65$ if R is in ohms, C in microfarads, and F in kilocycles.

Now, if you take a conventional amplifier and connect its output to the input of such a phase-shift network, then connect the output of the phasing network back to the input of the amplifier tube, at the predetermined frequency the phasing network will add its 180-degree shift to the 180-degree shift inherent in the tube. As a result, the feedback signal will be in phase with the input signal and will reinforce it. Figure 1 shows a block diagram of such a circuit, with an isolation amplifier ahead of the active circuitry.

So far, we have the exact circuit of a con-

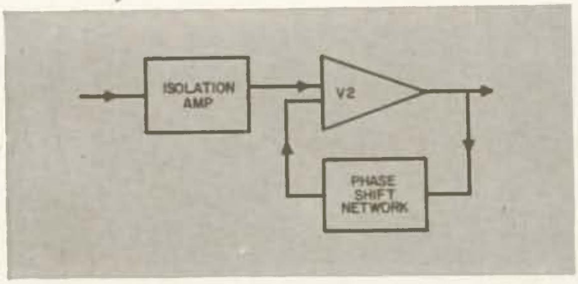


Figure 1. Block diagram of phasing filter.

ventional phase-shift oscillator, and you're probably thinking that the positive feedback we've caused will make the amplifier take off wildly at this one particular frequency.

This would be true, except for one thing. The triple RC phase-shifting network has a rather high loss. To be exact, only 1/29 of the signal applied to its input gets through to the output. Oscillation can occur *only* when the gain around the loop is equal to one or more.

Thus, by keeping the gain of the amplifier tube lower than 29, it can't oscillate. However, the positive feedback does increase the tube's gain drastically. And at any frequency other than that for 180-degree phase shift, the feedback signal will be partially or completely out-of-phase with the normal input signal.

For instance, if the frequency is such that phase shift through the feedback loop is only a few degrees, the feedback voltage will be almost completely out-of-phase with the input. In addition, if the tube gain is adjusted for maximum selectivity (more about this later) the feedback will be almost equal in amplitude to the normal input. The two will then almost completely cancel each other out, leaving a null point in the response.

As mentioned earlier, if the tube gain is 29 or more, the total loop gain will be 29 (tube gain) times 1/29 (phasing-network loss) or one—which allows oscillation. Another way of putting it is that gain goes to infinity and bandwidth to zero at the oscillation frequency.

However, if tube gain is, say, 28, then the gain around the loop will be only 28/29. Since this is less than one, the thing won't oscillate—but its gain will be high at the center frequency (812, as a matter of fact) and the bandwidth will be on the order of 100 cps at the 6 db points.

Now, if tube gain is reduced to unity, the loop gain will be only 1/29, which will produce only a bare bump on the response curve. At this point, bandwidth is at a maximum and selectivity at a minimum. You can see that selectivity is directly influenced by the tube's gain.

This effect is illustrated graphically in Fig. 2 for various values of tube gain. You can see that, no matter what the tube gain, the gadget also acts as a low-pass filter. Here's why:

Forgetting the phase-shifting action of the network for a moment, you can see that it's also a high-pass filter. Standard filter theory tells us that it will have 9 db attenuation at the frequency which makes capacitor reactance equal to resistor resistance—which is somewhat higher than the phase-shift-design frequency. From that point downward its attenuation becomes greater with frequency at the rate of 18 db per octave. Above that point its attenuation approaches zero.

Since attenuation at the higher frequencies is low, naturally there will be greater feedback through the network at the upper end of the frequency range. Except for the phase-shift properties, which are for the most part concentrated in a rather narrow region, this feedback will be negative. This, then, reduces the amplifier's gain tremendously, without regard for the selectivity-control setting.

As an example, the unit shown in the photos—which has a 480-cps center frequency as a CW filter—cuts off most frequencies above 2500 cps in the wide-band setting.

This is no disadvantage for most purposes—but it does bear mentioning.

Before going into construction details, here is the detailed design theory if you're interested; it will save you six weeks of research, because it has never been published previously:

Gain of the total filter stage is calculated by the standard feedback-amplifier formula:

$$Kf = K/(1 - KB)$$

where KF = gain of the stage with feedback
K = gain of the stage without feedback
and B = transfer function of the feedback network.

The only difficult thing about this filter circuit is calculation of B for this formula—the transfer function of the feedback network. By use of standard circuit theory, it was eventually found to be:

$$B = 1/(5X^2 - 1) + j/(6X - X^3)$$

where X = ratio of reactance to resistance at particular frequency
and j = square root of −1

It was found easiest to calculate B separately for various values of X, then substitute back these values against definite values of R and C to determine frequency, simultaneously taking the values of B thus calculated into the feedback formula, to determine the response of the amplifier for various values of tube gain and input frequency. The result was the curves of Fig. 2, which have been approximated by straight lines in the drawing.

The formula for choosing C, given R and F, is derived from the transfer function by determining that the second term must disappear for phase shift to be exactly 180 degrees. The only real value of X which will cause this term to reduce to zero is the square root of six, and substituting this value into the standard capacitive-reactance formula results in the FRC = 65 equation given earlier.

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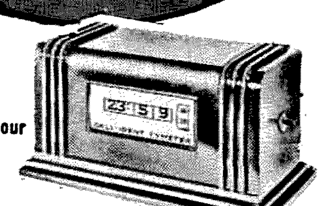

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- Clock runs continuously
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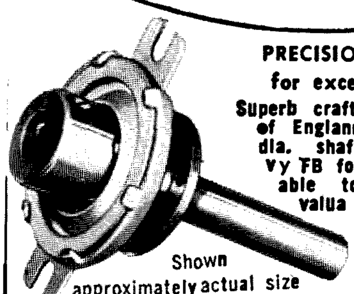

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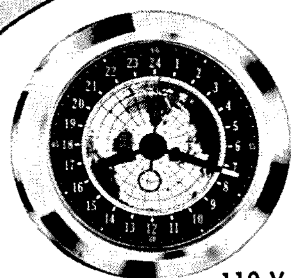

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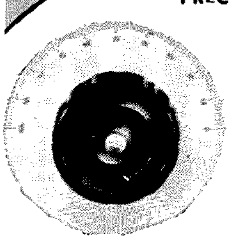

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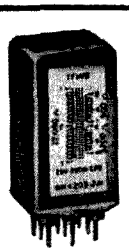

Same as used in W2EWL SSB Rig — March 1956 QST. Three sets of CT windings for a combination of impedances: 600 ohms, 5200 ohms, 22000 ohms. (By using center-taps the impedances are quartered.) The ideal transformer for a SSB transmitter. Other uses: interstage, transistor, high impedance choke, line to grid or plate, etc. Size only 2" h. x ¾" w. x ¾" d. New and fully shielded.

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SAY! YOU SAW IT IN 73

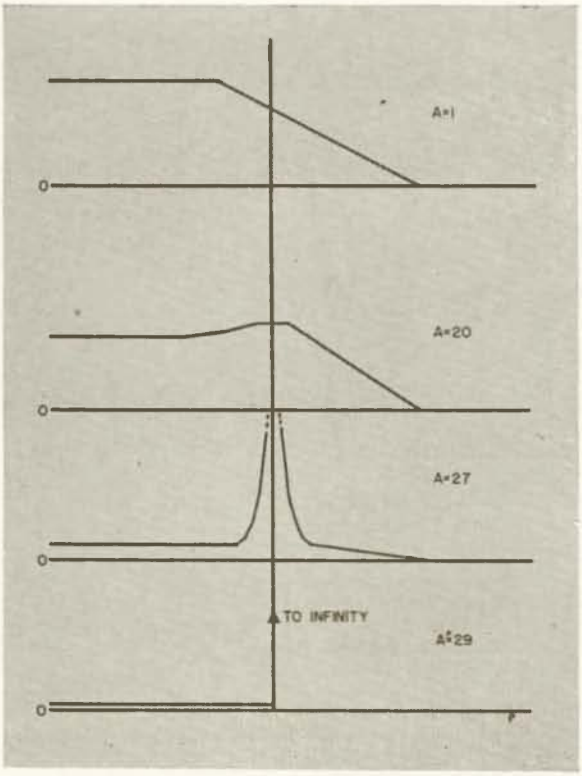


Figure 2. Output variation with frequency as a function of V2 Gain.

Enough engineering talk. Let's get on with building the filter.

Constructionally speaking, there's no critical wiring. You can build it as an outboard unit, like the one shown, or—if you can find room for a 12AX7 you can put it inside the receiver. Since the selectivity control is in a cathode circuit at low impedance to ground, its leads can be relatively long with no hum problems.

Parts values, likewise, are relatively uncritical. The common cathode resistor can be anything from 100 to 1000 ohms, and the phasing-network resistors can be anywhere from 22,000 to 100,000 ohms (with proper adjustment of the capacitance values). Only the plate load resistor has definite requirements—it should be within 20 percent of the 220K value specified, to get tube gain up to 28 for maximum selectivity.

Power requirements are 6.3 volts at 600 ma for filaments, and 250-300 volts at approximately 15 ma for plate supply.

When completed, the filter must be hooked into the receiver. This is best done by breaking the present connection at the upper end of the volume control and inserting the filter at this point, adding an input capacitor if necessary to isolate dc from the tube grid. Since this is an active rather than a passive filter, it *must* be placed ahead of the volume control. Otherwise, the set's output will probably run you out of the room.

With the filter inserted, set it for minimum selectivity (5K pot in maximum-resistance position) and turn on the receiver. Tune to one of the Novice bands and adjust for proper reception of a signal with a beat note of about the pitch you built the filter to pass.

Now crank up the selectivity control slightly. If the signal doesn't get louder, tune carefully to vary the pitch a bit and see if it peaks. If you still get no effect, crank up the selectivity some more.

Somewhere in the process, you'll discover the peak point of the filter. Leave the tuning alone from here on in, but adjust selectivity slowly until you reach maximum. You'll probably have to turn the volume down a bit as you proceed. Now, listen for the other signals you undoubtedly heard all around the desired one when you started this process. You can still find them, if you listen closely, but they're way, way down. This is the ideal situation for CW reception, since you can still tell how bad the interference is but the signal you want is in the clear for copying.

The reason for interaction between the selectivity and volume is implied a few paragraphs back—gain of the filter tube, at center frequency, varies from approximately one to more than 800 as you adjust the selectivity control. This means that you must cut back the audio to keep the same signal output level.

At about this point, you may be multiplying that gain figure of 812 times the 1-volt maximum input and trying to reconcile the theoritical 812-volt output with the 10-volt figure quoted.

Here's what happens: The tube can deliver only so much output, no matter what its gain. As overall gain goes up, the tube runs into saturation, thereby clipping all signals at a 10-volt level.

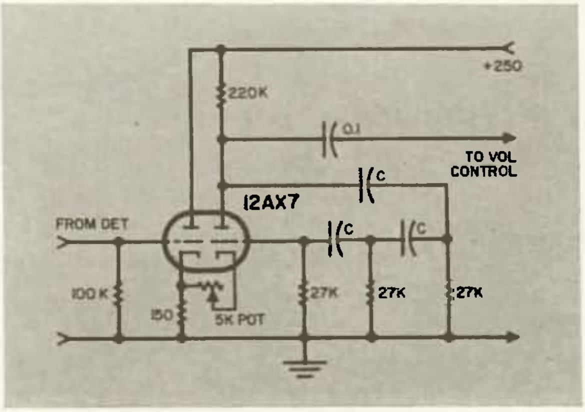
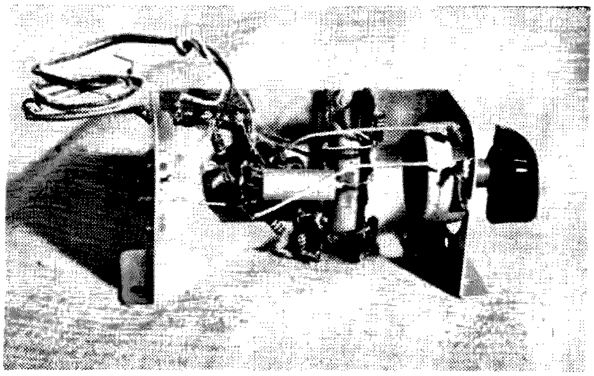


Figure 3. Phase Shift Filter. Values of three capacitors (C) are determined by frequency desired. Formula is:
$C=0.0024/F$ where F is frequency in kc.

However, the feedback process cleans up the clipped signal to the point that no distortion is noticed. Bandwidth remains narrow, and the result is a clean, in-the-clear signal to copy. As an additional benefit, noise pulses are clipped off also, making an additional noise-limiter unnecessary.

This filter has even been used to copy 80-



meter signals through hash from a nearby TV receiver's horizontal oscillator, complicated by a washing-machine motor, an electric fan, and the neighbor's power saw. No better testimonial can be written—without the filter, the signal couldn't even be found in that mess!

. . . K5JKX/6

An xyl's Lament

The dishes are done, the chillun's abed,
The cat is out, and the dog is fed.
The house is quiet, the day is complete,
And I am practically out on my feet.

There is the bed, so snug and warm,
I've longed for it since early morn.
But, do I go, now that all is done?
Of course not, now's the time for fun!

For mine is the hobby of grid dip and load
Of learning some theory, and practicing code.
Of checking the meter and logging the call.
What am I? A radio amateur, that's all.

I tune up the rig, (I'm starting to smile)
Turn the beam to the north (we'll try there for awhile).
And amid all the calls of CQ, CQ,
I clean forget I'm tired and blue.

There's that VE4 I've been trying to get,
And the happy voices of the Clam Diggers Net.
I'm a mother, yes, and proud of it too.
But I'm also an amateur, a ham like you!

Muriel Joan Smith, WA2GXT

Jim Kyle K5JKX/6
1851 Stanford Avenue
Santa Susana, California

A Quick and Simple Mobile Rig

Conversion of a Citizens Band Unit

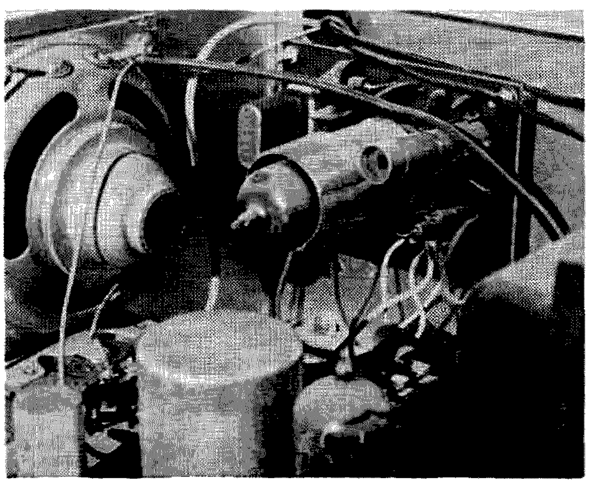
DISCUSSION still rages about the Class D citizens band, and since we ain't mad at nobody we aren't taking any sides—but it's true that many persons are getting an introduction to radio communication through CB activity, and some of them are becoming hams.

Naturally, since ham-type operation is prohibited on 27 mc, they find they have an item of equipment which is unusable in their ham efforts.

Change of subject briefly. With sunspots on the rapid wane and the low expected some time early in 1964, the higher-frequency bands are going to become as dead as the VHF regions are now. The DX chasers are going to be forced to come down to 40 and 80, thus crowding the rag-chew gang and the mobiles to other bands.

The conversion procedure described here provides one answer to both the situations mentioned above. For the CBer-turned-ham, it's a way to use his existing equipment. For the mobileer crowded off the high end of 75, it's a fast way to get on another band which won't be so crowded.

The starting point is a CB transceiver in working order. We used an International



KB-1, but similar principles apply to all of them and we'll take some time to show a few direct applications to other rigs.

Like many other CB rigs, the KB-1 is a superhet receiver combined with a 5-watt plate-input transmitter. Power supply and audio are shared by both transmitter and receiver. The conversion to ham-band usage consists of two steps: converting the receiver, and converting the transmitter.

Before we start converting, though, let's pick the band we're going to use. In this conversion, we're moving to 20 meters, on the assumption that 20 will be dead for DX within a year. Similar procedures would be used to go to any other band desired.

The KB-1 receiver is a double conversion type, with a crystal-controlled-converter assembly feeding a tunable *if* strip. This part of the conversion is simplicity itself, since International makes converter boards for the KB-1 covering 20, 15, 10, and 6 meters in addition to the CB board. Just get the replacement board, remove the original (unsoldering seven connections), replace it with the new one, and reconnect the seven leads. Receiver conversion is now complete.

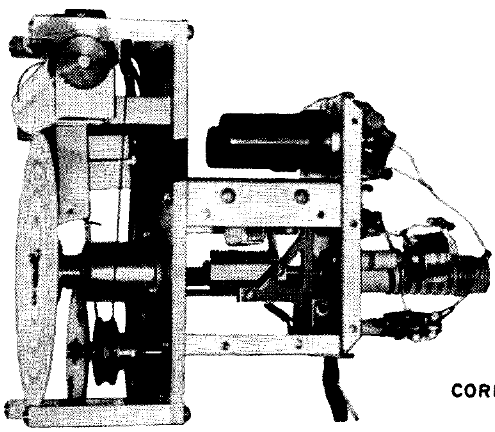
The transmitter board of the KB-1 consists of one printed circuit board, bearing a crystal, two coils, some resistors and capacitors, and a 6AU8 tube. As shipped from the factory, the board is pre-tuned for operation at crystal frequency into a 52-ohm load at a power input of 5 watts.

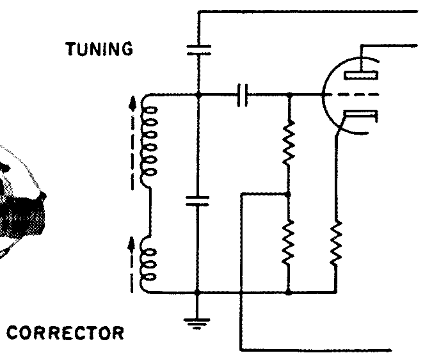
For most efficient operation, some surgery was required on the 20-meter board installed here. Values of two resistors and one capacitor were changed, and three turns were removed from the plate winding of coil L2. Power output was raised from less than a watt to about 1.5 watts at the same input, and linearity of modulation was increased greatly. The changes are shown in detail on the schematic diagram. Since they will prob-

WHAT MAKES THE VFO IN A 200V LINEAR?

A combination of a unique electrical circuit and mechanical correction system.

The main tuning is accomplished by turning a shaft ten times to cover one megacycle between 5 and 6 mc. The main tuning shaft advances a powdered iron slug into a coil to lower the frequency. The main tuning coil is wound at a non-uniform rate; so the frequency versus dial rotation approaches a linear characteristic. Since it is difficult to control the winding accuracy to provide exact dial linearity over the one megacycle range, a second coil is connected in series to provide vernier frequency correction. The slug of





this second coil is mechanically arranged to obtain correction information from a hill and dale track created by the ball-shaped ends of 23 adjustable screws. One of the screws appears every 50 kc in an adjustment hole accessible through a plug button on top of the VFO. By progressively adjusting these screws, it is possible to make the output frequency zero beat with the kc scale every 50 kc across the VFO range.

The adjustments should be made using a crystal calibrator that has been set for zero beat with WWV.

73 Wes

Write for a 200V brochure with detailed specifications

Wes Schum, W9DYV

Central Electronics, Incorporated

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ably improve operation of the 15, 10, and 6 meter transmitter boards as well, let's examine the reasoning behind the changes.

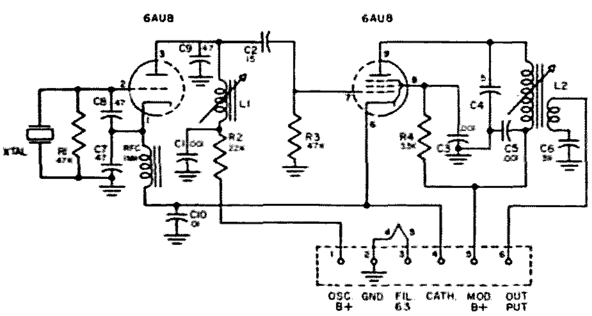
Capacitor C4 was increased in value to improve the Q of the output tank circuit; if an antenna of other than 50 ohms impedance is used, it might be well to leave C4 unchanged. The coil change increased output by increasing coil Q for the same amount of capacitance.

Resistors R1 and R3 were both originally 47K ohms, since in CB service the KB-1 output stage is operated as a frequency doubler. In this type of operation, high bias (obtained from large grid resistors) is essential to get any kind of efficiency in the doubling process. However, when the unit is operated straight through a crystal frequency, both resistors must be reduced to 15K ohms to increase the tube's conduction angle and thus improve power output.

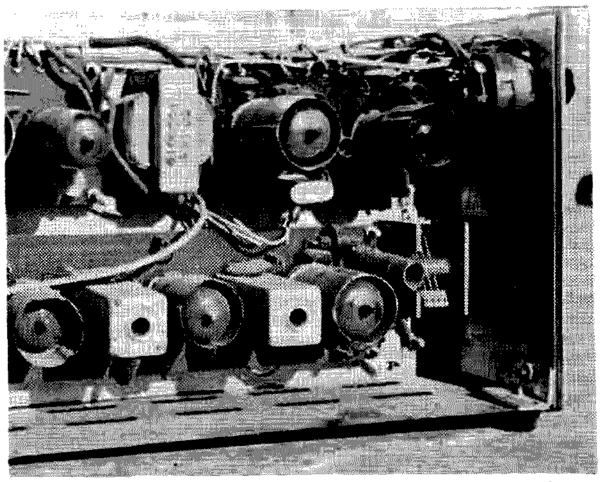
One other change is made in the transmitter-board installation. Originally, the blue lead of combination modulation-output transformer T1 supplied modulated B+ to the final. Tests showed that the mismatch introduced to the transformer resulted in less effective modulation than if Heising-type constant-current modulation were used. Therefore, the blue lead is left disconnected (tape the end to prevent shorts) and the final B+ (eyelet 5) is connected to the plate of the 6AQ5 (brown lead to transformer). The resulting modulation level is approximately 30 percent higher than before, for the same audio input.

Physical installation of the modified transmitter board is a bit tricky. First remove the speaker and the 6AU8 tube. Then, with plenty of patience, remove the four attach-nuts. At this point, unsolder the five connections (eyelet 2 is blank) to the board and lift the board free. Install the new board, tighten the four nuts, and resolder the five connections, being sure to modify the final B+ connection as described above. Replace the tube, and finally mount the speaker back in place.

This completes the conversion, and you're ready to go on the air. Keep in mind that 1½ watts of output into the antenna isn't much on 20 at the moment, and don't expect to slam



Conversion to 20M: Change R1 to 15K, R3 to 15K, C4 from 36 mmfd (not 5 as marked) to 51 mmfd, and remove three turns from L2 primary. A 14,250 kc crystal will put you in the AM part of the phone band.



through over he California kilowatts! However, when the activity drops off a bit this unit should give an effective 10-mile working radius, adequate for local mobiling.

The receiver, rated at 0.2 microvolt sensitivity, is one of the hottest this writer has ever seen on 20. Its selectivity (10 kc at —30 db) could stand improvement, but when the band is relatively quiet this unit digs in and pulls the weak ones through. Even under marginal conditions, if the signal is present at all this receiver will make Q5 copy out of it. The squelch takes a couple of microvolts to operate, making it a bit of a luxury on 20, but when signals are strong enough to trigger it properly it works just like the book says.

Earlier, we said we'd show direct applications of this gimmick to other CB rigs. The modified KB-1 transmitter board (designated as unit D) is available from International, and may be used to replace the transmitter section of any CB rig which operates at 250-300 volts on the plates. The receiver boards are only applicable to double-conversion superhets with a 6-mc tunable *if*, though.

If your CB rig uses single conversion, or is a superregen, the best bet is to retune the front end and oscillator. Using a grid-dip meter, remove turns from the appropriate coils until the signal-frequency circuits tune to the ham band you want and the oscillator tank circuit tunes to the ham frequency *plus* the amount of the *if*. In other words, to tune 20 meters, adjust signal-frequency circuits to cover 14.2 to 14.35 mc and the oscillator circuit (if your *if* is 455 kc) to conver 14.655 to 14.9 mc.

Since the CB rigs do not include circuitry, and addition of a BFO would play havoc with the noise limiter and squelch, modification to cover CW bands or to receive SSB is not too practical. However, for low-power AM use, such a conversion makes a quick and simple mobile rig. The only thing lacking is power—and we're working on that. Look for a later article on a 50-watt outboard amplifier for the converted citizens bander. . . . K5JKX/6

Wm. W. Goldsworthy
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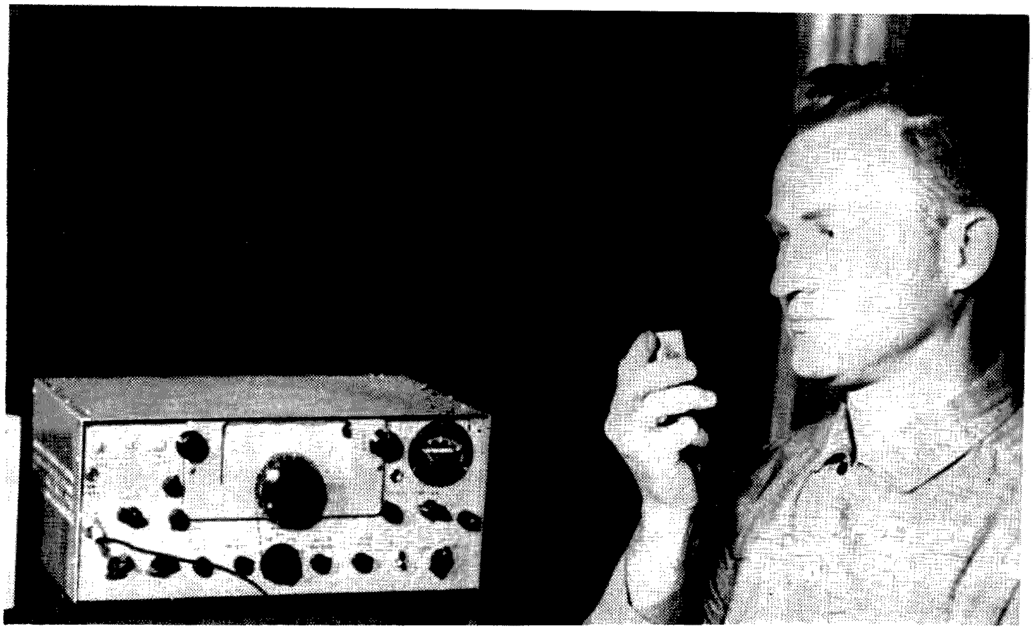


Single Sideband Transceiver

THE single sideband transceiver to be described was built mainly from war surplus parts but has the features, versatility, and performance found only in the best single sideband equipment. With a little bit of sweat, a lot of patience, plenty of time and a certain amount of scrutinizing at the local surplus stores, this entire rig should easily be built for under a hundred dollars.

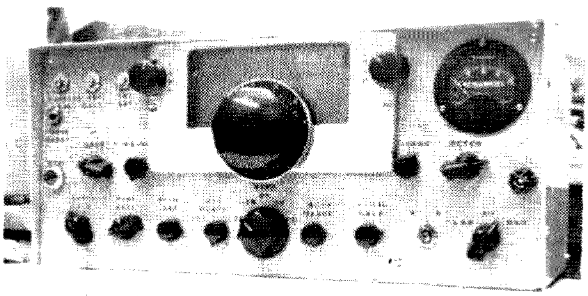
This single sideband transceiver covers all of the amateur phone bands from 10 through 75 meters. It will operate on upper sideband, lower sideband, or AM, has a peak power input capacity in excess of 200 watts, can be either manually or VOX operated, switches antennas when changing bands, has phone patch provisions, provides for the monitoring of final plate current, antenna current and external field strength, and is completely contained in a cabinet measuring only 15¾″ long, 9″ deep and 7″ high.

To those of the ham fraternity who have operated SSB transceivers little need be said regarding their merits, especially when SSB mobile operation is contemplated.

Basically this transceiver is of quite straightforward design, using the filter method for suppression of the unwanted sideband and for providing an extremely high degree of receiver selectivity. Fig. 1, showing the block diagram, shows both transmitting and receiving sections of the transceiver sharing a common VFO, a common master osc. and a common *if* amplifier circuit.

An easy concept to understanding SSB transmitters is to think of them as a superheterodyne receiver in reverse, starting with an audio signal and ending with an rf signal.

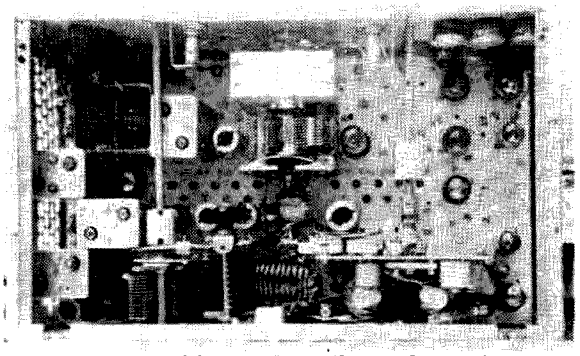
The use of a high frequency, high selectivity lattice filter eliminates the need for double conversion both in the transmit and receive



sections of the transceiver, since the high frequency of the *if* amplifier eliminates the problems of image rejection and the high selectivity of the lattice filter provides the degree of selectivity normally obtained only at low frequencies. This greatly simplifies both band switching and send-receive switching and greatly reduces the number of tubes and tuned circuits required without reducing performance. One of those high frequency lattice filters can be purchased for around $40 or can be readily assembled from surplus components for a couple of dollars and a little time.

In talking with many hams on the air, the mere mention of building a "filter rig" petrifies them and for the heck of it I cannot understand why. In reality, the filter rig takes less equipment for its alignment and construction than the phasing job, is just as easy to construct, and I am sure that most experienced SSB hams will agree with me that it is the preferable way to build a SSB rig. The performance of a transceiver using one of these high frequency half lattice filters compares very favorably with that obtained from the better quality sideband gear at a fraction of the cost of these commercially built units.

The ability to grind or etch crystals and wind coils, and the access to a VOM, a VTVM,



and a reasonably well calibrated receiver are the only prerequisites necessary to build this SSB transceiver.

To facilitate convenience of operation of this transceiver many features have been incorporated into its design, such as VOX operation, bandswitching, good selectivity, good bandspread, good stability, both SSB and AM operation, monitoring of antenna current as well as final plate current, and antenna switching with band switching. Also the rig had to be equal in quality to the better quality SSB gear, and be relatively easy to construct and service.

There are several circuits used in this transceiver that do not follow usual amateur SSB design. These are the use of a fully balanced modulator, a fully balanced product detector and a fully balanced mixer, the use of a high level mixer to directly drive the final amplifier, the use of proper matching between receiver mixer and the lattice filter to obtain higher receiver performance, the use of a built-in antenna current meter to facilitate tune-up, the use of a final amplifier screen regulator not using VR tubes, and the use of a coupling driver between the output of the *if* strip and the high level mixer or product detector to improve linearity.

Basically the transmitter rf section is quite simple and straightforward. A crystal controlled master oscillator develops the original signal at either a frequency of 5.438 mc or 5.442 mc, being either slightly lower or slightly above the *if* pass band, and as in most filter type SSB rigs, passes into a balanced modulator followed by a 2 section cascaded high frequency half lattice filter having a pass band of approximately 3 kc at 5.440 mc. The output of this filter is then amplified through 2 *if* amplifier stages operating at 5.44 mc and fed to the grids of a high level balanced mixer through a push-pull coupling follower. The cathodes of this high level balanced mixer are driven directly from the VFO plate tank through balanced coupling links and the output of this balanced mixer drives the parallel connected 6146's in the final amplifier.

The *if* amplifier, the VFO and the master oscillator are common for both the receive and transmit operations and all send-receive switching circuits with the exception of the antenna relay, are electronically switched to avoid the use of special relays in the send-receive switching operation.

The receiver section is also quite straightforward, consisting of an rf stage using a cascode connected 6BQ7, a mixer stage using a 12BE6, two *if* stages, an AM detector, a balanced product detector and two stages of audio amplification.

Very conventional audio, VOX, and anti-VOX circuits are included which provide for VOX operation, push-to-talk operation, manual operation and loudspeaker operation using VOX.

Use of High Frequency Lattice Filters

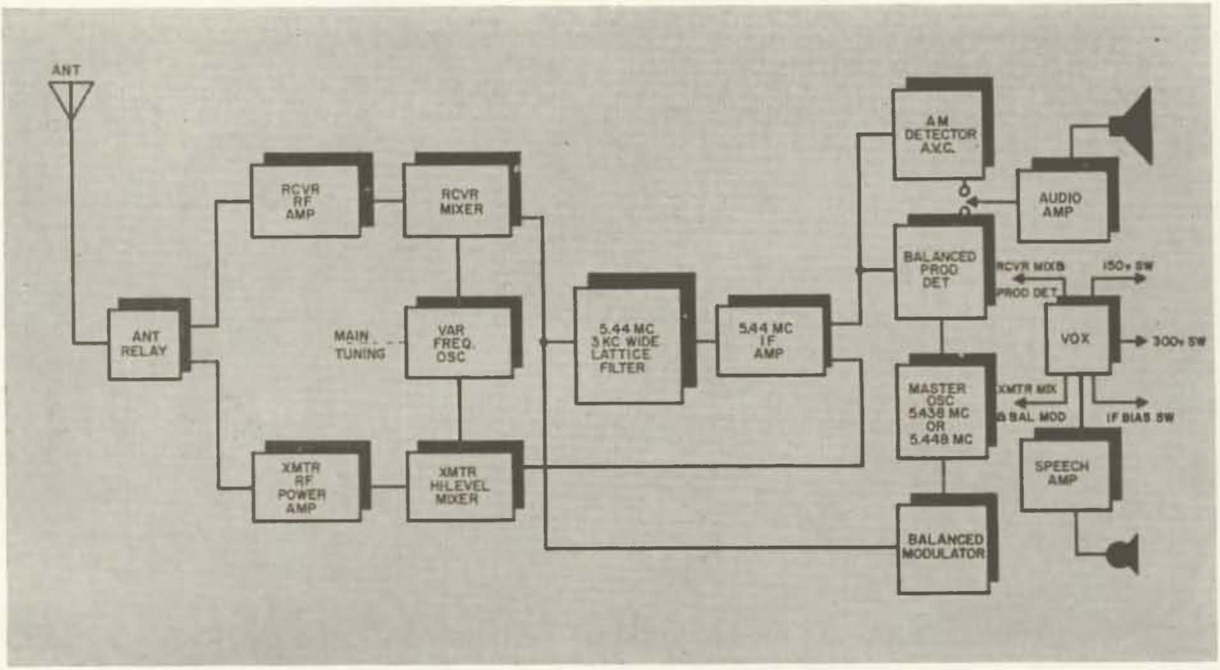
As more hams are experimenting with high frequency lattice filters, many of the techniques necessary for the proper adjustment and construction of these units are being determined. There have been a number of articles written regarding the construction of these filters as well as ways to improve their performance.[1]

Like most other experimenters, I dug into the problem of constructing a cascaded half lattice filter by reading the existing articles available and then doing the construction and testing. I was somewhat disappointed at first in the performance of these filters in that they exhibited too much dip in their pass bands and too low an impedance to match correctly with the output of a receiver mixer stage. Both of these shortcomings were finally overcome by the installation of a proper impedance matching network between the mixer output and the filter input, which greatly reduced filter insertion loss and produced flat topped band pass response. The impedance matching transformer used to couple into the lattice filter accomplishes an impedance transformation of about 10 to 1 to more properly match the lattice filter to the output of the mixer.

In constructing the cascaded half lattice filter it is important to have excellent isolation between its input and output terminals. This can be achieved easily by simple shielding procedures. The coupling transformer (T2) is constructed by bi-filar winding two lengths of #28 gauge wire on a ¾" toroid form.[1]

Use was made of surplus FT243 crystals in the 5.4 mc region for the elements of the lattice filter. These crystals, when properly aligned and used, will produce a flat band pass characteristic for about 3 kc with extremely sharp skirt selectivity and transmitter adjacent sideband rejection equal to the more expensive SSB commercial units on the market.

The first step in the construction of the lattice filter, which is the most important single unit in the transceiver, is to obtain several surplus FT243 crystals in the 5.5 mc region. These can be obtained reasonably at most surplus stores. Crystals in the frequency ranges between approximately 5.2 and 5.8 mc can be used, keeping in mind that these fre-



Block Diagram: SSB Filter Transceiver. Send-Receive switching is accomplished by: 1) Relay switching antenna circuits; 2) Electronically muting the receiver mixer and product detector in the transmit mode and muting the transmitter mixer and balanced modulator in the receive mode; 3) Switching if bias; 4) Switching 300 volts to receiver audio or final screen.

quencies are approximately halfway between the 7 and 3.5 mc bands, allowing for a reasonable separation between *if* and signal frequencies when operating these two bands. Grinding or etching of the crystals in the lattice filter should be done with enough accuracy to provide a separation of 1500 cycles between the crystal pairs.

When choosing the proper crystals at the surplus store, it is wiser to select those of a single make and frequency to insure similar crystal and holder dimensions. This will result in a minimum amount of crystal shifting. Once the crystals are ground and assembled, they can be soldered permanently into place in their shield can. Care should be taken in selecting crystals to insure that there are no spurious crystal responses of consequence within a 100 kc of the *if* pass band on either side.

Mixer Muting and Design

One source of difficulty experienced in the design of a transceiver is the problem of regenerative feedback occurring back through the unused mixer where the *if* amplifier is common is both receive and transmit modes. Unwanted oscillations will occur if means are not taken to insure that the transmitter mixers are completely muted in the receive condition, or if the receiver mixers are not muted completely during the transmit condition. The usual means of inactivating the mixers is to short one of the mixer inputs and remove the input signal from it, but this requires relay switching of the high frequency rf circuits. Another approach which is employed in this transceiver is to mute the unused mixers electronically by applying the correct bias to cut off the unused mixers. (The term "mixer" applies to mixers, balanced modulator and product detector, which are all forms of mixers.)

In order to keep the distortion products and spurious responses to a minimum, the high level mixer, the balanced modulator and the product detector are all of double balanced input design. The use of a double balanced mixer for driving the final amplifier stage allows for moderate power handling capability with fewer undesirable mixer products, greater attenuation of the VFO signal which is cancelled by the push-push arrangement of this stage and greater attenuation of the even harmonics of the *if* frequency, one of which appears near the edge of the 21 mc band.

The balanced product detector used in this transceiver has the advantage over the single ended variety in producing fewer undesirable mixer products. A true product detector should produce only products between the incoming signals and the local oscillator and not those between various incoming signals. The methods used here to accomplish this is to apply large oscillator signal level, low input signal level and to provide a push-push arrangement for cancelling the beats developed between various incoming signals in its audio output. Sideband quality comparable with AM is obtained by using a product detector of this design. This should really appeal to the died-in-the-wool AM boys.

The product detector circuit uses one double triode (V13). The grids of this tube are driven

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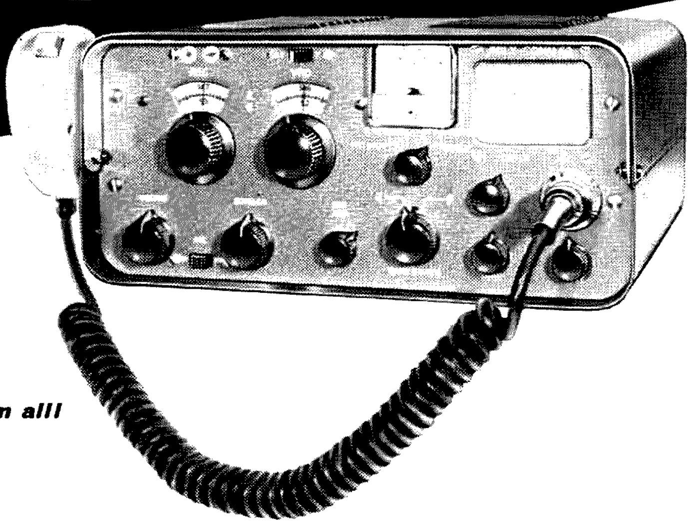

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in push-pull from the attenuated output of transmitter mixer driver, applying only a small fraction of the *if* output signal to its grids. The cathodes are also driven in push-pull from one of the bi-filar wound link coils on the master oscillator (BFO) plate transformer (T5). The cathode resistor R79 has been selected to provide proper bias for good mixer operation. Grid signals which mix with each other due to the non-linearity existing in two tube halves of the product detector cancell in the anode circuit since the generated signals are 180° out of phase from each half.

The above reasoning about balanced product detectors was also applied to the balanced modulator stage which is also completely balanced with respect to both circuits.

VFO Circuit

Good oscillator stability is one of the most important considerations when dealing with SSB since a small amount of drift will require frequent retuning to reestablish intelligibility. This can be quite a nusiance to all concerned and can easily be avoided by careful planning. There have been numerous articles written regarding VFO's, VXO's and heterodyning oscillators. The VFO, of all of these types, takes the least amount of space and circuitry for the amount of flexibility and stability desired and with moderate care, excellent stability can be obtained on all bands. The simple variety VXO circuits were also considered with the conclusion that these were less stable than a good VFO.

All of the frequency determining elements in the transceiver have been placed where they will be away from heat. The Clapp type oscillator was chosen for the VFO circuit since its ability to isolate the effects of tube change on the oscillator frequency is extremely good. All components in the frequency determining circuits have been rigidly mounted and placed so that heating from other components is kept to a minimum. In the frequency determining circuits, good quality low temperature coefficient inductors and capacitors are used. Silver mica capacitors and low negative temperature coefficient ceramic capacitors are used along with good quality, HI-Q low temperature coeffcient B&W Miniductor stock.

In order to reduce frequency dependence upon the contact condition of the band switch, all frequency switching is accomplished only across low impedance parts of the frequency determining circuits. Capacitor C12 in the VFO grid circuit is used to prevent parasitic oscillation from occurring.

If the oscillator is properly built, stability in presence of plate loading changes, voltage changes, and temperature changes should be excellent, being more than adequate for good SSB operation on all ham bands from 75 through 10 M. Actually the largest effect of frequency change in a properly built Clapp oscillator comes from filament voltage change. This being a considerably larger effect than from plate and screen changes. This constitutes no problem when ac line operation is used, but does when an automobile electrical system is used with its inherently poor voltage regulation. If mobile operation is contemplated, the power supply should contain provisions for regulating the VFO filament, such as a shunt zener diode or a series transistor regulator.

Miscellaneous Considerations

In dealing with any transmitter using linear amplifiers, it is of utmost importance to provide good neutralization. Anyone who thinks he can get away with neutralizing a class AB1 linear without providing a large amount of grid swamping, is in for a shock when he tries it. A quick calculation of the amount of rf feedback through the inter-electrode capacities of a beam power tetrode such as a 6146 into a high impedance grid circuit, is certainly a great convincer. Balanced bridge neutralization, which is a convenient way of providing grid neutralization for a tetrode amplifier stage, was used mainly for its compatability with simple band switching circuits. Since the final amplifier driver is a mixer stage, there is no need for its neutralization since all inputs and outputs are on widely separated frequencies. There is also less need for circuit isolation from input to output of this stage for the identical reason.

Tuning Controls

Front panel adjustment of all bandswitched rf circuits is provided by front panel controls to insure the ability to tune all circuits accurately. Each of the individual tuned circuits has an individual trimmer placed across it to allow preset alignment for each band, thereby reducing tune-up time when changing bands.

The main tuning dial which controls the VFO frequency provides a frequency coverage only across the amateur phone bands from 10 through 75 in five bands. This provides the high degree of band spread desirable for SSB operation. Normally, controls other than the main dial need not be realigned with band switching when proper alignment of each band has been once attained.

A control is also provided on the front panel for carrier injection when talking to hams using ancient modulation.

The transceiver was also well tested for TVI with excellent results. Without any additional filtering of the antenna output, no difficulty was encountered with a TV set located two feet away from the rig with feedline closely paralleling for at least 10 feet.

Construction Details

Above all, in a unit of this size and com-

plexity, a certain amount of care must be exercised in its layout. To facilitate easy duplication of the unit as far as general, layout Fig. 2 shows the basic chassis layout that should be followed to prevent unwanted feedback. This layout is the result of a very careful study of all problems concerned and represents one of the best possible parts layouts for ease of assembly, ease of servicing and freedom from unwanted circuit coupling.

Most of the wiring is all point-to-point with the aid of terminal strips, with the exception of filament wiring, control wiring, power wiring and some audio circuit wiring. All rf wiring is kept short to prevent circuit interaction, and a minimum amount of shielding is used to reduce the number of chassis fabrications needed.

Since many hams wishing to duplicate this transceiver will undoubtedly wish to use as much junk box and surplus components as possible, I will attempt to point out what should or should not be used in certain cases.

VFO Construction

All of the VFO components should be rigidly mounted to avoid shift of frequency from shock or vibration and should be mounted away from heat generating components such as vacuum tubes, power resistors, VR tubes, etc. If the proposed chassis layout is followed, this will occur automatically.

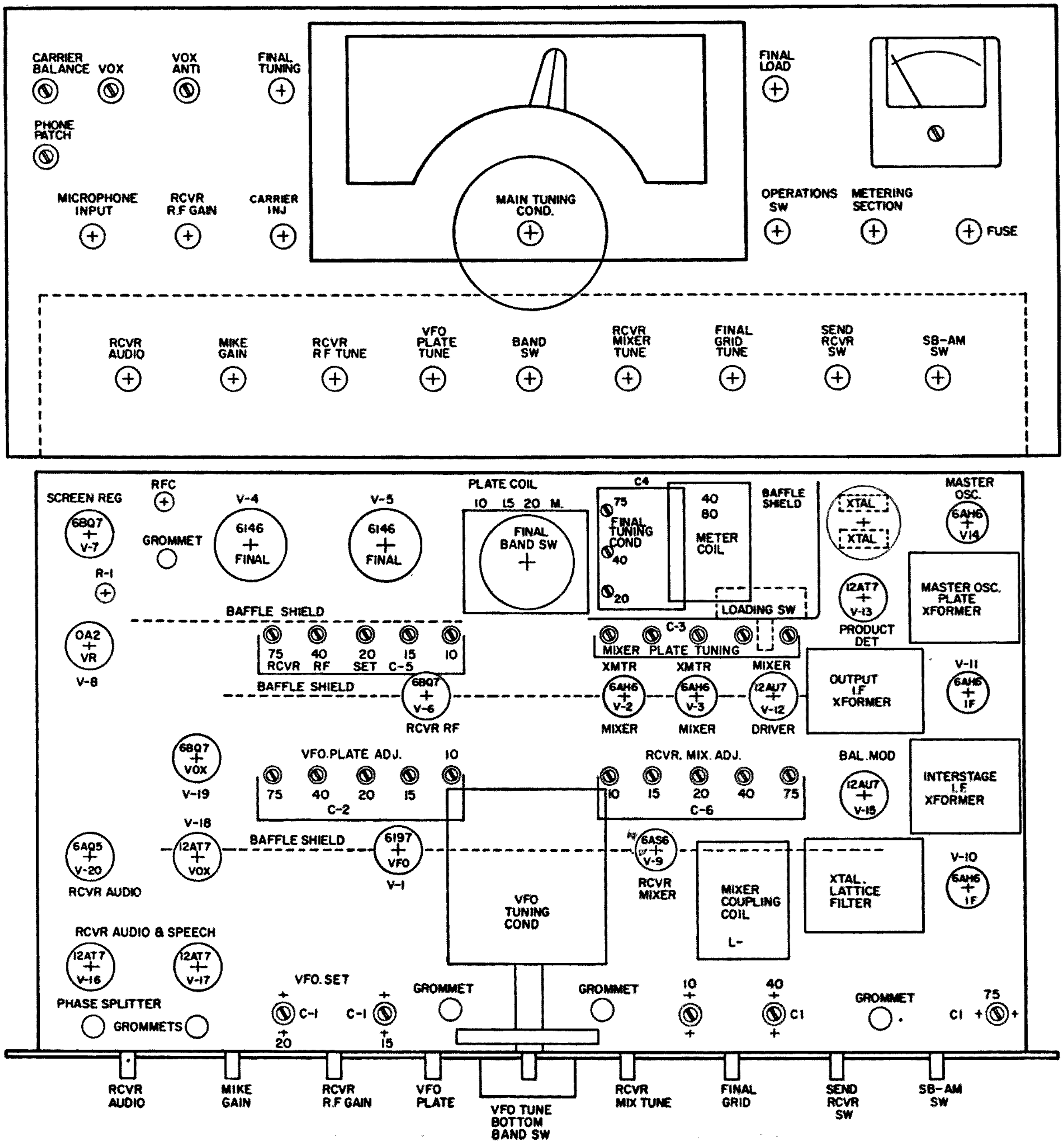
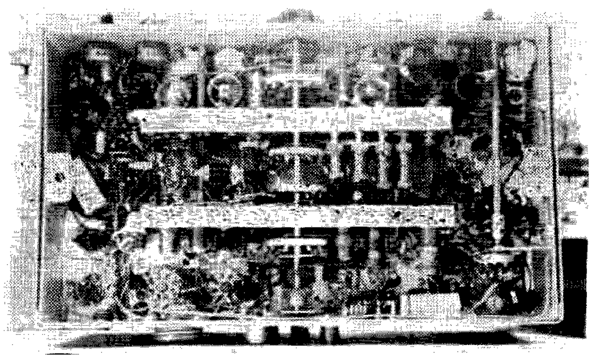


Fig. 2



As has been pointed out earlier in this article, excellent frequency stability can be easily obtained from a Clapp oscillator if a few simple precautions are followed. These are: to rigidly mount all components, to use inductors having high Q and high thermal stability, to use a good grade of low temperature coefficient capacitor for the frequency determining circuits, to provide band switching in only the low impedance parts of the frequency determining circuits, to apply regulated voltage at least to the screen of the oscillator, and to place the oscillator tube's grid-cathode circuit across as low impedance part of the oscillator grid tank as possible.

Some temperature compensation may be desirable and can be placed into the tuned circuits of the oscillator upon final alignment. Almost all of the compensation that is finally needed to provide a minimum of frequency drift on warm up will be necessary because of the positive coefficient of drift of the oscillator tank circuit inductors, and the better the choice of inductors, the less need there will be for temperature compensation. Also, these inductors should have as high a Q as possible, since higher values of Q permit a looser coupling of the frequency determining tanks to the oscillator tube, thereby reducing frequency shifts caused by tube parameter variations, such as filament and anode voltage shifts. The commercially available B&W Miniductors are one of the best choices for oscillator tank inductors as these units have extremely high Q's and exceptional temperature stability. Filament voltage shift is the more serious of the above mentioned tube parameter variations, and causes a shift not only in the operating transconductance of the oscillator tube, but also a much larger effect, the shift in the oscillator tube's grid input capacity by thermal effects.

A good quality dial and condenser assembly should be used to provide stable and convenient SSB operation. The dial should preferably have a high reduction ratio for smooth SSB tuning, and the condenser should preferably be one in which the rotor grounding is accomplished through wipers rather than through ball bearings, as ball bearing ground returns can cause considerable frequency instability. There are a number of good dial condenser combinations on the surplus market, and the one used in this transceiver was one designed for use in the National RAO surplus navy receivers. This particular condenser had to be cut down from three to one section to fit in the available space, and a condenser was employed in series with this condenser in order to reduce its tuning capacitance from 240 to 100 mmfd and to improve its tuning linearity.

Placement of the various oscillator grid tanks where they have adequate spacing from ground is desirable and no difficulty should be encountered in running fairly long leads from these tank circuits, through the bandswitch and to the oscillator's grid and cathode, if a single precaution is taken. This precaution is to place a capacitor of about 40 mmfd directly from the grid of the oscillator tube to ground at the oscillator tube's socket. This capacitor will prevent the oscillator from going into parasitic oscillation because of the lead inductance in the wiring between the oscillator tube and the frequency determining tank circuits.

Care should also be used in adjusting the Clapp oscillator to prevent squeezing, which may occur if the grid resistor is too high in value or if too much feedback is used. Feedback in the Clapp oscillator is easily controlled by varying the ratios of the grid-cathode capacitors with respect to the other series capacitors in the oscillator tank circuit. Unfortunately, a change in these ratios will also produce a change in frequency coverage provided by the main tuning condenser, which is in parallel with the grid-cathode capacitors, but with a little juggling of the coil inductance, the proper amount of band spread for the main tuning dial can be easily obtained on each amateur band. The oscillator tuning condenser is the only one connected to the main tuning dial, and readjustment of the other tuned circuits which are pre-aligned for each amateur band is only necessary when covering the entire ranges of the 75 and 10 meter bands. These other tuning adjustments, which are receiver mixer tuning, oscillator plate tuning, receiver rf tuning and final grid tuning are conveniently grouped on each side of the band switch knob for easy retuning.

In order to reduce the effects of frequency pulling when tuning the plate of the oscillator or when changing its load, as in the case of switching the final driving mixer on and off during the transmit and receive switching, frequency doubling is done in the oscillator on all bands.

A single inductor is used in the plate circuit of the VFO for all amateur bands. This is done for two good reasons. The first being that fewer band switching positions are needed on the main band switch, and secondly, only one balance adjustment need be made on the links coupling to the final amplifier driving mixers cathodes for all bands. Voltage drives to the cathodes of this mixer must be well balanced to prevent the oscillator signal and the even har-

monics of the *if* frequency from appearing in the final amplifier's grid circuit. One pole of the band switch is used to switch the various size capacitors needed across the oscillator's plate tank for proper resonance on each band and to also switch in the appropriate tank loading resistors, whose function it is to equalize oscillator output with band changing in order to maintain uniform mixer drive on all bands. The various oscillator plate trimming capacitors should be adjusted so the oscillator plate circuit resonates in the center of each band with the front panel oscillator plate control set at mid-range. This procedure also applies to the tuning of the receiver mixer, the receiver rf, and the final amplifier grid tuning circuits.

There are a few more words of caution in regards to frequency stability of the VFO. Make sure that grounds made with any bare wire, like the return leads of one of the VFO frequency determining capacitors, be not allowed to rest against the chassis except at the point of intended connection, as the change in lead inductance will have effect on the frequency. It is also advised that all shafting in the vicinity of the oscillator coils be non-metallic, since those metallic shafts can cause shorted, unstable coupling circuits with the oscillator tanks. Even the two shafts driving the final tuning and final loading capacitor should be broken with insulators to avoid any undesirable coupling with the oscillator. Both of the above causes of instability were actually encountered and had to be corrected.

Balanced Final Amplifier Driving Mixer

This stage is driven by the VFO output in a push-pull cathode drive arrangement and by the output of the *if* strip in a push-pull grid drive arrangement. A double push-pull drive parallel plate arrangement was chosen to provide a great deal more attenuation to oscillator frequency, *if* frequency and even harmonics of the *if* frequency than can be obtained from single ended mixer arrangements. Fewer additional tuned circuits are therefore required to suppress the unwanted mixer products to a desired low level.

A grid driver consisting of a push-pull cathode follower is used to provide low distortion drive to the current drawing grids of the mixer and a small portion of these signals are also tapped off to drive the product detector grids. Because of the proximity of the mixer drive circuits to the receiver mixer, ground returns from both of these stages should be separated as widely as possible to prevent feedback at the *if* frequency. To further reduce the tendency for regeneration at *if* frequency, the grid cathode circuit of the balanced mixer is neutralized to prevent feeding of the *if* output through the grid cathode capacitance of the mixer into the oscillator circuit, back through the receiver mixer, and then into the *if* amplifier again.

Actual balancing of the mixer drive from the oscillator is accomplished by shifting the position of the three turn link coils mounted at each end of the oscillator plate tank. The outputs of these link coils must be phased and adjusted properly so as to produce two equal potential out of phase voltages of approximately 7 to 10 volts on all bands.

Receiver Mixer

The receiver mixer is of quite conventional design using a 12BE6 pentagrid converter tube. Some care is, however, needed in preventing the over-driving of the signal input grid of this mixer from unwanted oscillator coupling. A reasonable amount of judement in the placement of the VFO plate coil and the mixer grid coils will produce the desired degree of isolation without additional shielding. The oscillator plate coil should be placed at right angles to the mixer coils at a reasonable distance away. Over-drive with oscillator signal at the mixer's grid will produce a loss in conversion transconductance, and will be noticeable, if present, by a decrease in gain accompanying the proper resonating of the oscillator plate tuning. The actual loss in conversion transconductance occurs when grid circuit rectification produces large bias changes.

IF Amplifier

This amplifier, operating at approximately 5440 kc, uses two stages; the first being driven by the low impedance output of the lattice filter, therefore requiring no neutralization, and the second one being driven from the high impedance output of the first *if* amplifier and requiring neutralization. To anyone who does not believe in neutralizing high frequency *if* stages, a quick calculation of the amount of signal fed back through the low value of grid plate capacitance of a pentode to its high impedance grid circuit should be the only argument needed. Of course, it is possible to load the grid circuit with a resistor to prevent oscillation, but only at the expense of *if* gain and selectivity. At first glance, selectivity seems unimportant because of the lattice filter, but the greater the *if* selectivity after the filter, the better will be the rejection of any unwanted spurious crystal responses in the vicinity of the *if* frequency.

Neutralization of the last *if* stage is by balanced bridge neutralization and requires only the addition of two small condensers and a resistor.

Detectors

There are two detectors provided; one for AM reception and one for SSB reception. The AM detector which also provides AVC voltages, is a full wave diode rectifier circuit, and

the SSB detector is a balanced product detector. AVC action on AM is of the normal type, while AVC action on SSB is of the fast charge, slow discharge type. AVC action on SSB delivers the proper signal level to the input of the product detector for all signal levels, thereby producing distortion free SSB reception.

Audio circuits in the receiver section are quite conventional and the audio output stage is muted during the transmit phase to prevent driving from the AM detector which is active on both transmit and receive conditions. Muting is accomplished in the audio output amplifier circuit by removing the screen voltage from this stage and placing a small amount of negative voltage to this screen.

Master Oscillator

This oscillator, which is crystal controlled and operates slightly below or above the lattice filter's pass band for upper sideband, AM and lower side band operation, provides the BFO injection signal to the product detector in the receive condition and the master oscillator signal to the balanced modulator in the transmit condition. The two frequency determining crystals are switched in by the USB-LSB-AM selector switch with one of the crystals being used also for AM, and this switch also selects the type of AVC action desired automatically, provides detector audio output switching automatically, and allows the oscillator screen voltage to be switched off in the AM receive conditions to eliminate the local injection signal.

Coupled to the master oscillator's plate tank are two link coils, one going to the product detector cathodes and one to the balanced modulator cathodes, respectively. Both of these link coils are bi-filar wound so as to produce balanced push-pull voltages for good balance in the product detector and the balanced modulator. The placement of the product detector and balanced modulator in close proximity to the master oscillator plate coil was carefully planned, so that as short a run possible is made with oscillator signal leads. An excess amount of radiation from the master oscillator signal will seriously impair the operation of the *if* amplifier by over driving the *if* amplifier with oscillator signal, thereby reducing the signal *if* gain by allowing amplified oscillator signals to be fed into the AVC rectifier circuit.

Balanced Modulator

This modulator is one in which both audio and master oscillator are fed in push pull, and the outputs are parallel connected. Further improvement in carrier balance is accomplished by the cathode plate capacitor balance adjustment provided. This adjustment is made for a minimum of carrier feed-through during final alignment.

Receiver RF Stage

This stage is a cascode connected amplifier of standard design. Muting of this stage is necessary on the transmit condition to prevent unwanted feedback; this being accomplished by applying positive bias to the cathode of this stage during the transmit cycle.

Final Amplifier

The final amplifier uses a pair of parallel connected 6146's. This amplifier is operated in class AB1 and will handle in excess of 200 watts PEP input on SSB. Neutralization is provided by balanced bridge grid neutralization which is absolutely necessary.

The output of the 6146's is fed into the Pi network output circuit which has provision for pre-alignment of the loading for each band. Provisions are also made for switching of all antennas with the main bandswitch, if desired. The usual plate parasitic chokes are included, and screen and cathode by-passing is made with .01 disc. capacitors directly from socket pins to ground. No trouble was encountered with the final amplifier once neutralization was performed. A slight departure is made from the usual VR tube screen regulator, and in its place is used a cathode follower screen regulator. This regulator has the advantages over the VR tube types in that low regulator idling current is maintained, the operating voltage of the regulator can be easily changed, and only one tube is required in comparison to at least two VR tubes.

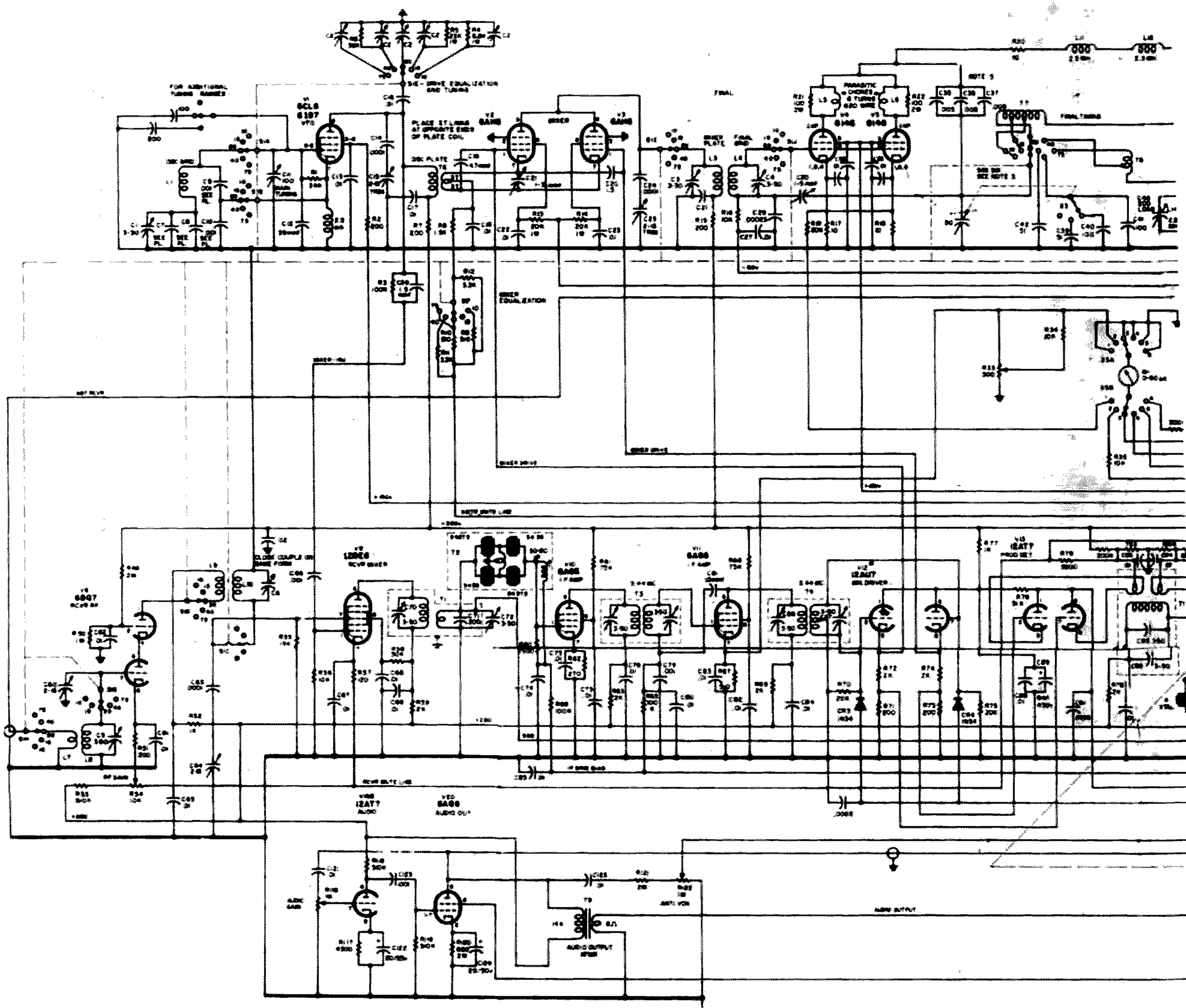
Front Panel Controls

All transmit and receive circuits, along with antennas and antenna metering adjustments, are switched by operating the single main band switch on the front panel.

Control knobs are supplied on the front panel for the tuning of all rf stages, antenna loading, receiver gain, rf gain, receiver audio gain, mike gain, carrier injection, operating mode, meter selection, and band switching. Front panel set screw adjustments for carrier balance, VOX gain and anti-VOX gain are also supplied, for these less frequently required adjustments.

With six months of operations now chalked up with this rig I am even more pleased with it than the day I first put it on the air. Operating it has been a real pleasure and using it as a portable has been effortless. I won't make the usual claims of the large amount of DX worked but I will say that the rig has as much punch as any of the SSB exciters or mobile transceivers, is more compact and is the first complete radio station I have had that can be carried to the car in only one trip.

1. Vesper, Surplus High Frequency Crystal Filters, QST Jan. '59.
2. Vesper, Mobile SSB Transceiver, QST June '59



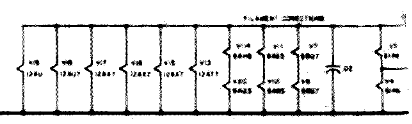
NOTES:

1. MAIN BAND SWITCHES SHOWN IN 20M POSITION. ALL BAND SWITCHES HAVE 5 POSITIONS
2. [illegible]
3. 2 SWITCHING POLES-PARALLELED
4. DO NOT USE PADDERS ACROSS L4 OR THE 15 AND 10M BANDS. SPREAD COILS TO RESONATE WITH INPUT CAPACITY OF THE 6146s ON THESE TWO BANDS
5. CONDENSERS PARALLELED FOR LOW LEAD INDUCTANCE

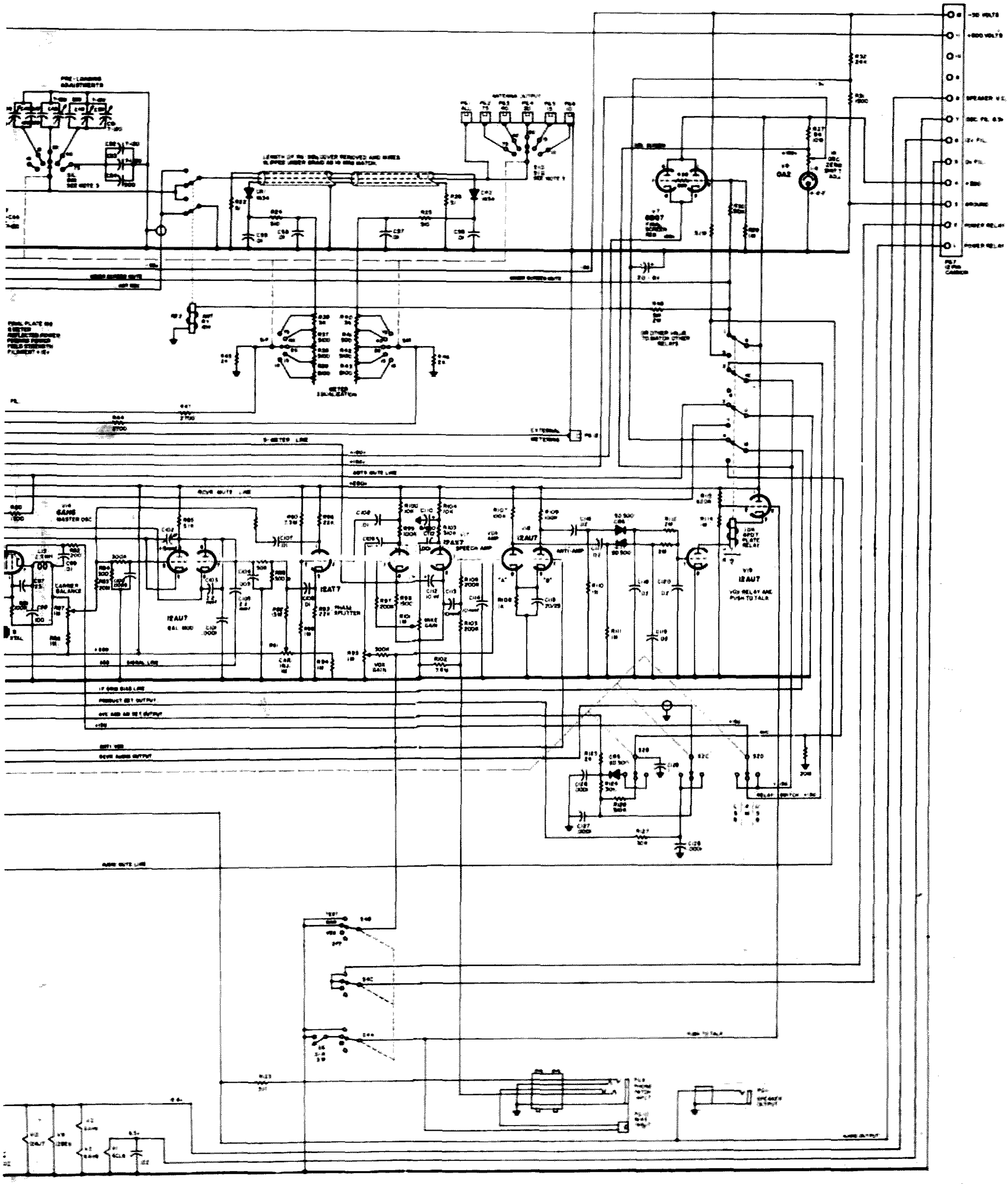
BAND	RANGE L1 ADJUST TUNE IN MC	
10M	11.380	11.880
15M	7.880	7.980
20M	9.380	4.450
40M	8.320	8.380
75M	4.420	4.720

BAND	RANGE TO ADJUST TUNE IN MC		TUNES
10M	23.160	23.760	25600 26200
15M	15.750	15.960	21.200 21.450
20M	9.960	6.860	14.150 14.350
40M	12.840	12.740	7.200 7.300
75M	8.240	8.440	3.800 4.000

C2 C3 C4 C8 C9	
10M	15-7mmf
15M	15-7mmf
20M	3-30mmf
40M	7-45mmf
75M	7-45mmf



FILAMENT CONNECTIONS


12AU7
12AT7
12AX7
SPEECH AMP
PHASE SPLITTER
EXTERNAL METERING
S-METER LINE

PARTS LIST

Part Number	Quantity	Description
C 1	5	Ceramic padder—See schedule on schematic
C 2	5	Ceramic padder—See schedule on schematic
C 3	5	Ceramic padder—See schedule on schematic
C 4	5	Ceramic padder—See schedule on schematic
C 5	5	Ceramic padder—See schedule on schematic
C 6	5	Ceramic padder—See schedule on schematic
C 7	5	Approximate values B—10 m 175 mmfd Silver mica capacitor A—15 m 85 mmfd Silver mica capacitor N—20 m 100 mmfd Silver mica capacitor D—40 m 225 mmfd Silver mica capacitor S—75 m 100 mmfd Silver mica capacitor
C 8	5	Approximate values B—10 m 30 mmfd Ceramic N080 A—15 m 15 mmfd Ceramic N080 N—20 m 15 mmfd Ceramic N080 D—40 m 30 mmfd Ceramic N080 S—75 m 15 mmfd Ceramic N080
C 9	5	Actual values
C10	5	B—10 .001 mfd Silver mica A—15 .001 mfd Silver mica N—20 .001 mfd Silver mica D—40 .0015 mfd Silver mica S—75 .001 mfd Silver mica
C11		100 mmfd variable—See text
C12		
C13, 17, 18, 22, 23, 26, 27, 31, 32, 33, 34, 55, 56, 57, 58, 61, 62, 65, 67, 68, 69, 73, 74, 75, 76, 80, 82, 83, 84, 85, 88, 92, 93, 94, 99, 106, 107, 108, 109, 121, 125	41	.01 mfd Ceramic Disc. Cap. 600v
C14, 24, 63, 126, 127, 128	6	.0001 mfd 600v Ceramic Cap. .0001 mfd 600v Ceramic Cap.
C15, 25, 60, 64	4	2-12 mmfd miniature variable cap.
C19	1	4.7 mmfd 600v ceramic cap.
C20, 59, 81	3	1.5 mmfd 600v ceramic cap.
C21, 30, 102	3	1-5 mmfd piston variable (miniature)
C28, 35, 36, 37	4	.005 mfd 2000v ceramic disc. cap.
C29, 97	2	.00025 mfd 600v silver mica
C38	1	50 mmfd double spaced variable cap.
C39, 42	2	51 mmfd 3kv ceramic
C40, 41	2	100 mmfd 3kv ceramic
C43	1	200 mmfd variable cap.
C44, 45, 48, 50, 51, 52, 53	7	7-120 mmfd ceramic trimmer
C46, 47	2	100 mmfd mica cap.
C49	1	.00025 mfd mica cap.
C59	1	.0005 mfd mica cap.
C66, 79, 111, 123	4	.001 mfd 600v disc. ceramic cap.
C70, 72, 77, 78, 86, 87, 95, 96	8	3-50 air trimmers—in IF cans
C71	1	200 mmfd silver mica cap.
C89	1	8 mfd 450v electrolytic cap.
C90	1	.00025 mmfd ceramic cap.
C91, 100, 104	3	.0005 mfd ceramic cap.
C98	1	.0001 mfd silver mica cap.
C101	1	50 mmfd ceramic cap.
C103, 105	2	2.2 mmfd ceramic cap.
C110	1	2 mfd 450v Electrolytic cap.
C112	1	10 mfd 6v Electrolytic cap. (miniature)

Part Number	Quantity	Description
C113, 114	2	10 mmfd ceramic cap.
C115, 122	2	20 mfd 25v Electrolytic cap. (miniature)
C116, 117, 118, 119, 120	5	.02 mfd ceramic disc cap.
C124	1	20 mfd 50v Electrolytic cap. (miniature)
CR1, 2, 3, 4	4	IN34 diode
CR 5, 6, 7	3	SD500 diode
Crystals	6	Approximately 5500 kc
S1	1	Band switch 10 pole, 5 pos., 5 wafer ceramic
S2	1	Band switch 8 pole, 5 pos., 4 wafer ceramic
S3	1	Band switch 1 pole, 3 pos., Ceramic
S4	1	Switch 2 pole, 4 pos., miniature (shorting)
S5	1	Switch 2 pole, 6 pos., miniature (shorting)
RE1	1	4 pole, 2 pos., miniature relay (10 ma coil)
RE2	1	2 pole 2 pos., miniature relay (6 ma coil)
M1	1	0-50 ma meter
PG1, 2, 3, 4, 5, 6, 7	7	coax female (831R amphenol)
PG8	1	12 pin female connector
PG9	1	3 sleeve phone jack-with extra circuit leaves
PG10	1	Amphenol 2 pin female mike connector
PG11	1	Phone jack
T1, 2, 3, 4, 5, 6, 7, 8, 9	9	See coil winding charts
S6	1	S.P.S.T. toggle sw.
V1	1	6CL6 vacuum tube
V2, 3, 14	3	6AH6 vacuum tube
V4, 5	2	6146 vacuum tube
V6, 7	2	6BQ7A vacuum tube
V8	1	OA2 Regulator
V9	1	12BE6 Vacuum tube
V10, 11	2	6AG5 vacuum tube
V12, 13, 15, 18, 19	5	12AU7 vacuum tube
V16	1	12AT7 vacuum tube
V17	1	12AX7 vacuum tube
V20	1	6AQ5 vacuum tube
L1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	14	See coil schedule

Miscellaneous Parts

Knobs

Shafts, Right angle drive

Shaft couplings

Tuning dial

Insulated shaft couplings

Nuts, washers, bolts

Chassis—cabinet

Wire—Shielded wire

Resistors

Part No.	Quantity	Description	Part No.	Quantity	Description
R2, 32	2	24K	R37, 38, 39, 41, 42, 43, 85	7	5.1k
R2, 7, 82, 15	4	200	R44, 47	2	2700
R3, 64, 65, 66, 81, 99, 107, 109	8	100k	R45, 59, 46, 63, 69, 72, 74, 78, 125	9	2000
R4	1	6.8k-1w	R48, 76	2	51k-2w
R5, 93, 96	3	22k-1w	R49, 112, 113, 121	4	2M
R6	1	39k-1w	R51	1	200
R8, 60	2	1500	R52, 77, 123, 79	4	1k
R9, 10, 24, 25, 67, 73	6	510			
R11	1	3.3k			
R12	1	3.9k			

R13, 14 ...	2	20k-1w
R16, 34, 35, 56, 100, 104	6	10k
R17, 18....	2	10
R19, 70, 75	3	20k
R20	1	10-1w
R21, 22 ...	2	100-2w
R27	1	10k 10w
R28	1	200
R54	1	10k pot.
R57	1	120
R58	1	30k-2w
R61, 68 ...	2	75k-1w
R62	1	270
R71	1	510
R80	1	1300
R83	1	20M
R84, 88 ...	2	300k
R87, 91, 95, 101, 116, 122	6	1M pot.
R30, 53, 103, 118, 119, 126	6	510k
R29, 50, 86, 89, 94, 110, 111, 114 .	8	1M
R31, 98 ...	2	1500
R33	1	500ohm pot.
R36, 40 ...	2	3k
R90	1	7.5M
R92	1	15M
R93, 96 ...	2	22k-1w
R97, 105, 106	3	200k
R108	1	1k
R117	1	4300
R120	1	680-1w
R124, 127..	2	30k

Ed. Note: All resistors ½ watt, unless otherwise stated.

Transformers	Pri	Sec 1	Sec 2	Pri-Sec Spacing
T1 Mixer Coupling 5.4 mc	65t #30 ⅝" dia. Close wound	20t #30 ⅝" dia. Close wound		Close wound
T2 Xtal Coupling 5.4 mc	2-25 turn bi filar wound on 1" dia. Toroid. #24 gr.		Total winding 80µh	
T3 Interstage IF 5.4 mc	50t #30 ⅝" dia. Close wound	50t #30 ⅝" dia. Close wound		½"
T4 Output IF 5.4 mc	50t #30 ⅝" dia. Close wound	50t c.t. #30 ⅝" dia. Close wound		½"
T5 Master Osc. Plate 5.4 mc	40t #30 ⅝" dia. Close wound	10t c.t. #30 Bifilar Wound	10t c.t. Bifilar Wound	
T6	13t #20 ½" dia. Close wound	3t #20 Insulated wire Close wound	3t #20 Insulated wire Close wound	Adjust to Supply 7-10v to cathodes of mixer
T7	10t #12 Air Wound 1⅛" dia. 1⅝" Long-tapped 4t and 6t			
T8	16t #14 on 1½" dia. form close wound—tap 11t			
T9	Output Audio transformer 14000—8 ohms			

Coil Winding Data

Band		L1	L3	L7	L8	L9	L10
10M	Turns Winding length Diameter	7½t 8t per inch 1" Miniductor	8t #20 ⅝" Air wound ⅝"	2t #20 Close wound ½"	9t #20 ⅜" ½"	9t #20 Close wound ½"	9t #20 ⅜" ½"
15M	Turns Winding length Diameter	13½t 16t per inch 1" Miniductor	12t #20 ⅞" Air wound ⅝"	3½t #20 Close wound ½"	11t #20 ½" ½"	11t #20 Close wound ½"	12t #20 ⅜" ½"
20M	Turns Winding length Diameter	26t 32t per inch 1" Miniductor	12t #24 ¼" ⅝"	4t #22 Close wound ½"	19t #22 ½" ½"	17t #22 Close wound ½"	19t #22 ½" ½"
40M	Turns Winding length Diameter	14½t 16t per inch 1" Miniductor	20t #24 ¼" ⅝"	7t #26 Close wound ½"	35t #28 ½" ½"	30t #28 Close wound ½"	35t #28 ½" ½"
75M	Turns Winding length Diameter	26t 32t per inch 1" Miniductor	35t #28 ½" ⅝"	11t #28 Close wound ½"	55t #28 ¾" ½"	50t #28 Close wound ½"	55t #28 ¾" ½"

L2—2.5 mh RF Choke
L4—Same as L3, ⅜" spacing between coils
L5, 6—6t #20 wound on 100Ω 2w Resistor
L7, 8—Close spacing between coils
L11, 12, 13, 14—2.5 mh RF Chokes

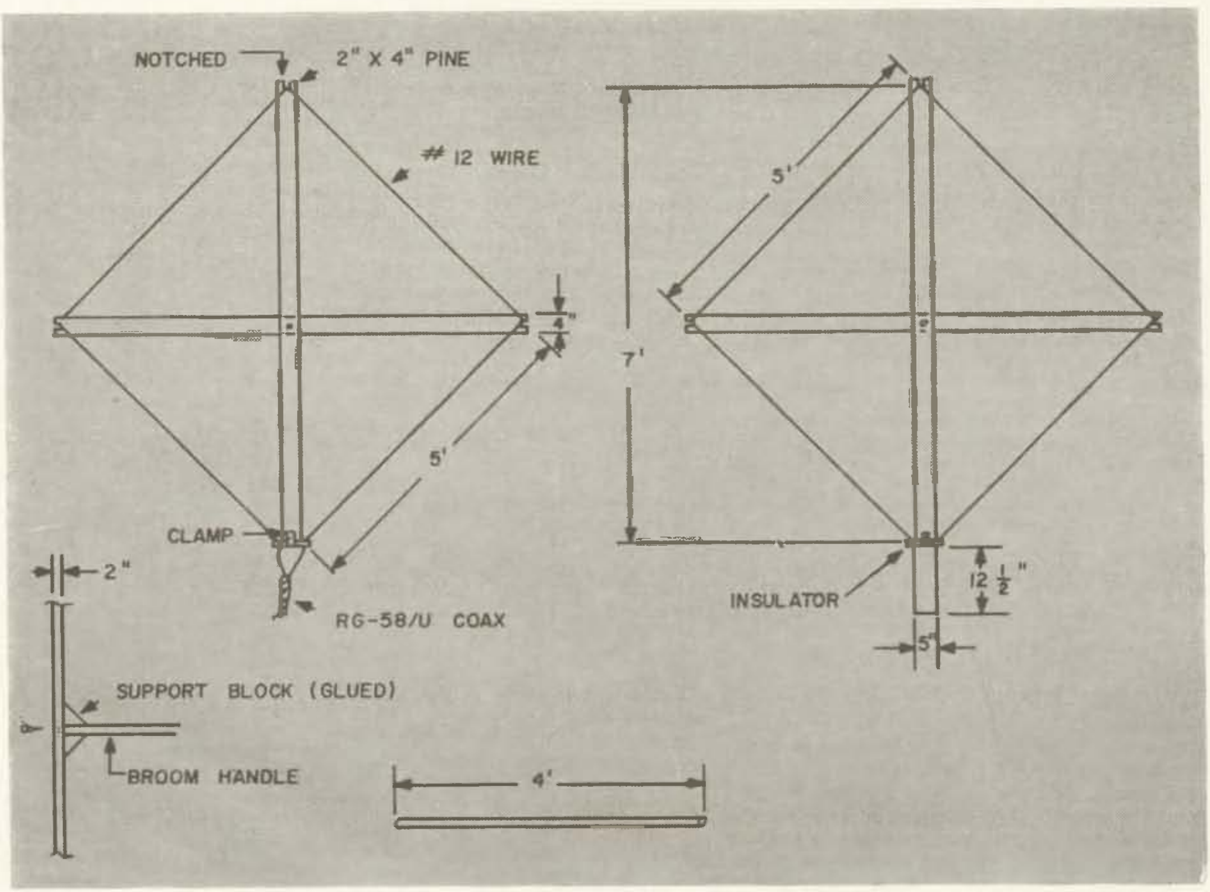
$6 Quad for Six

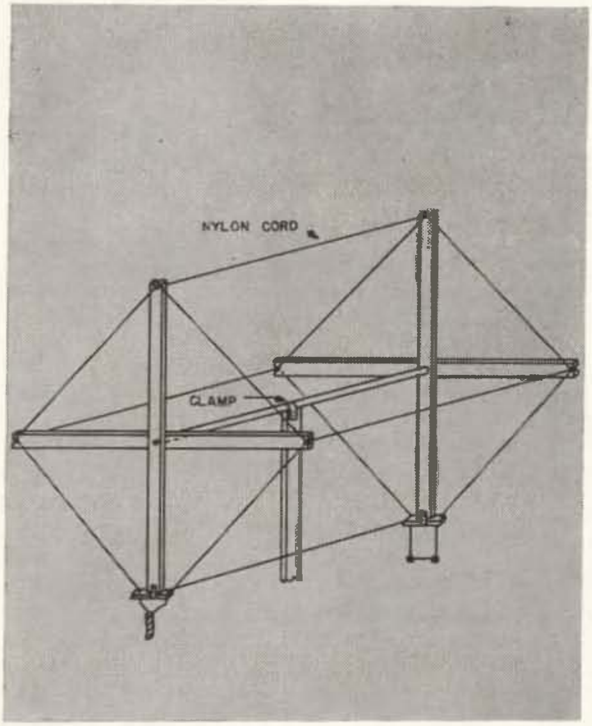
highly directive, high gain

Karl Brownstein W3TBF/ø
1363 W. Maynard Drive
St. Paul 16, Minnesota

WHEN operating on 6 meters I have always relied on a beam antenna. In Philadelphia I used a 9 element home brewed beam with excellent results. Lately I have been hearing a lot about the Quad. Being always interested in new types of antennas, I decided to build one. After building the Quad, I installed it and connected it to my rig (HT-40 and SX-140). The Quad performed beyond expectations and was therefore cause for this article.

This quad can be assembled from materials in the shack and some cheap lumber from the nearest yard. Before proceding with the construction of the Quad, it was necessary to work out some mathematical details. First I calculated the size of each side of the Quad using the following formula: $L \text{ (in feet)} = \dfrac{251}{F \text{ (in mc)}}$ Since my crystal frequency is 50.2 mc, my length for each side came out to 5 feet. Using high school math to find the hypotenuse, I was able to determine the size of the cross supports. Each side squared $\$^2 = 25$, $25 + 25 = 50$, the square root of 50 is approximately 7. Therefore, 7 feet was chosen as the cross support. At the lumber yard I obtained four 7 foot 2 x 4 pine. I decided to space the ends of the Quad 1/20th of a wavelength or 4 feet. A broom handle was chosen and cut to size. Having some #12 enameled wire, I decided to string the Quad with it. Placing the 4 inch side of the pine flat and crossing it with the other piece, I measured the point of crossing, which at center is 3½ feet. Upon marking this point I drilled a ¼ hole through both pine pieces. I then inserted a nut and bolt to hold them together while stringing.





I notched the ends with a file to receive the wire. Upon stringing the wire, I placed a 5 inch insulator at the bottom of the quad, and terminated the wire as shown. At this point I connected my 52 ohm coax line and soldered it. I completed the same operation with the reflector side, but extended the wire to 12½ inches on either side of the insulator. At this point adjustment may be necessary for the placing of the shorting bar. This bar may have to be varied depending on the SWR.

The antenna is now ready for assembly. Taking one side at a time, I removed the nut and bolt from the center of the crossed pines and inserted a 6 inch wood screw. I then screwed the cross onto the broom handle. This was repeated for the other side also. For rigidity I tied the cross pines to each other using nylon cord. Do not pull the cross pines any tighter than snug as they may snap. At this point the Quad is ready to be mounted on the mast. If desired a two meter Quad may be strung inside the 6 meter Quad and separately terminated for two band operation.

As I swing my Quad south from Minnesota and make contact with Dallas, Texas, I wish you one and all, "Good DX hunting with your Quad." . . . W3TBF/Ø

Diode Polarity?

Connect one end of the mysterious diode to a 6.3vac source and the other to a VOM set on 10 volt scale dc. If the meter reads up then that is the positive end of the diode.

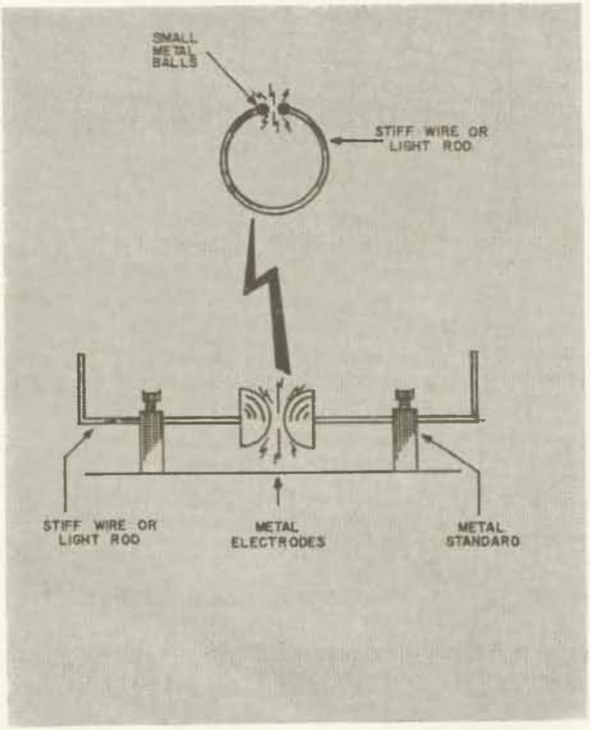
. . . K8BYO

Howard S. Pyle W7OE
3434 74th Avenue, S. E.
Mercer Island Washington

Evolution of the Ham Antenna

PICK up any handbook, be it of the general type or one specializing in ham antennas; examine any of the current periodicals dealing with amateur radio. Doesn't the multiplicity of antenna designs offered amaze you? And, whether you are a relatively new beginner or one of the old school in the ham ranks, the more you read the more confused you are likely to become! What can you choose which will give you the results you want within the bands you want to work as well as within the limits of your pocket-book and the space you have available for erection?

The advertising of scores of manufacturers offer a myriad of designs for both vertical and horizontal antennas for operation in one specific band or for so-called 'multi-band' operation. Writers offer others; some conventional, some novel, some downright weird. For the higher frequencies, 14 mc and up, there are even more styles than the many developed for lower frequency applications. Most of these work well; some are unfortunately rather mediocre but on the basis that 'anything metallic will radiate,' they all will work to a greater or lesser extent.



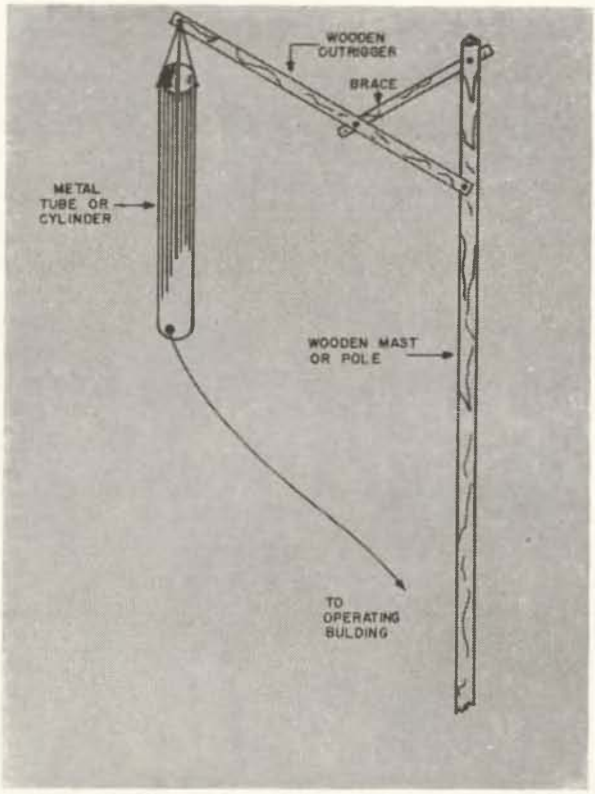
Prof. Hertz's transmitter. The spark between the two electrodes was transmitted to the small metal balls. The short wires served as antennas.

Remember that Prof. Clerk Maxwell and Prof. Heinrich Hertz, in the late 1800's, did not at first deliberately employ an 'antenna' with their spark coil experimental equipment. Initially it so happened that the short rods which they used between supporting posts for their spark gaps acted as 'radiators.' And too, their radiation with these antennas, which were not much more than a few inches long, must have been in the ultra-high frequencies; you figure it out if you like working some of the handbook formulas backwards! The inherent broadness of the wave generated by a spark discharge won't make it easy to determine however!

Hertz discovered this radiation phenomena through space when he found that he could pick up a minute spark between small closely spaced metal balls supported by a loop of wire. He also discovered that by making the electrical length of the loop equal to that of the rods of the spark gap the small spark picked up in the loop was considerably intensified . . . they were in "resonance." Hence, the name "resonator" which he gave to the loop and why we now know the radiation phenomena as "Hertzian wave propagation."

A few years later, Guglielmo Marconi devised a practical use for this radiation which, he reasoned, although confined to a most limited area with the crude equipment of Maxwell and Hertz, could be used to communicate *without* wires by using a code similar to that developed by Samuel Morse for his wired telegraph. Marconi's first concern was improvement of the radiating system. One of his earliest antennas resembled very closely a couple of lengths of what we know as 'stovepipe' suspended from a yard-arm on as high a mast as he could manage! It worked too, up to about 100 miles, even with the extremely crude and insensitive receiving equipment of that time! The down-lead perhaps did most of the radiating!

Later progress developed helical type tuning coils and similar 'refinements' (?), all of which apparently assisted in performance. Wavelengths, as such, were of little concern then, but with the addition of such coils and the development of increasingly longer and higher

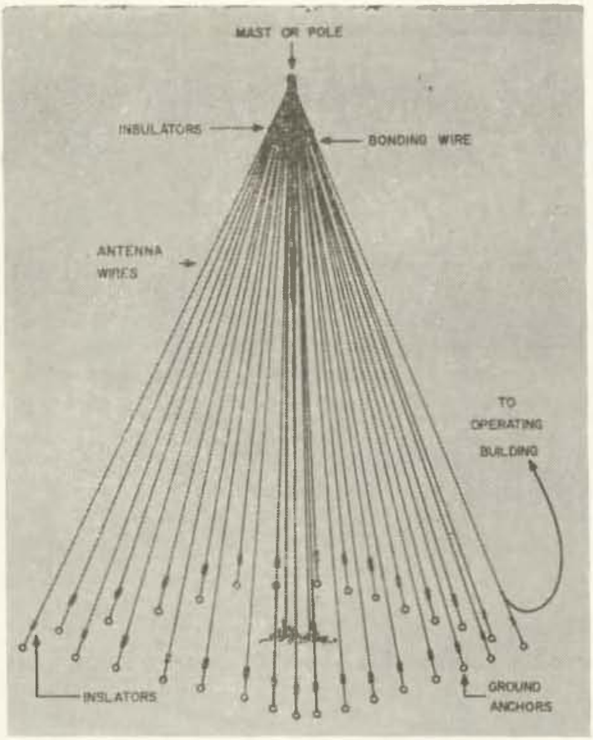


One of Marconi's original antennas used at some of his stations at the turn of the century. Anything metallic will radiate, but obviously the lead-in wire made a pretty good antenna by itself!

wire antennas with resultant increase in both inductance and capacity, wave-lengths could creep but one way . . . up!

So successful were the later multi-wire antennas of Marconi that pioneer amateurs, then beginning to enter this fascinating field, followed suit. Four, six and even eight wire antennas of as great a length as available space permitted, were suspended horizontally between trees, roof gables or masts. The four wire antenna proved most popular in commercial ship and shore station installations as with the amateur, for many years. A trend then developed toward reduction in the number of suspended wires and many amateurs were soon using but *two* parallel wires. Commercial companies were somewhat slower to follow, but within a few years two-wire antennas were becoming increasingly popular on merchant vessels.

It is difficult to say just when the adoption of a single horizontal wire for both transmission and reception occurred. Very probably with the amateur directly after he was permitted to resume operation some two years after the World War I armistice. In almost every case, such antennas were of the 'random length' type with little attention paid to length versus frequency. It was not long however, with the increasing popularity of vacuum tube over spark transmission, before it was discovered that if the radiating system was so made as to be resonant at the frequency on



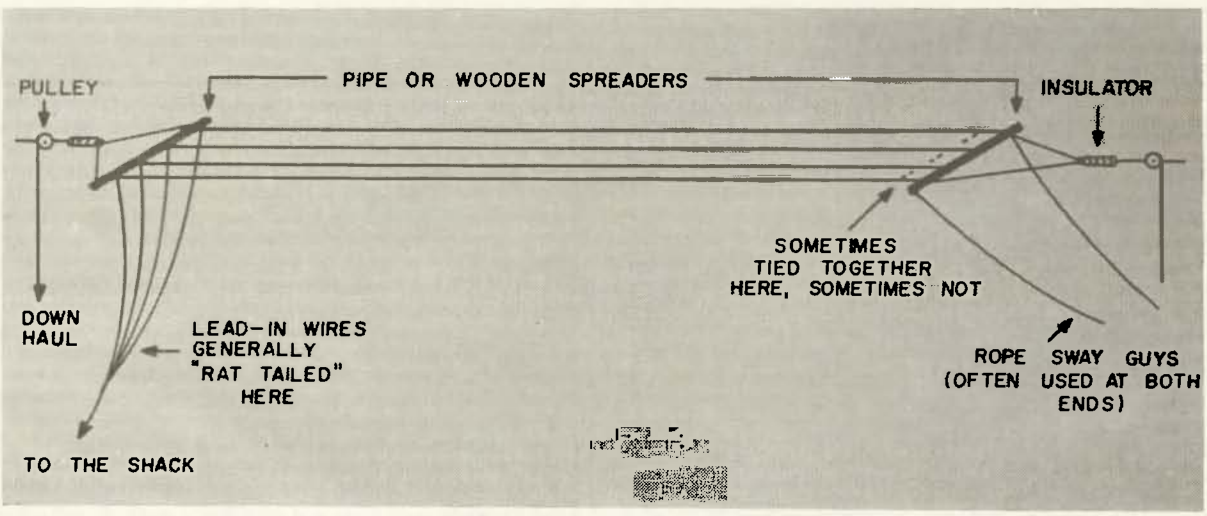
U.S. Army Signal Corps antenna used in the early 1900's. It was dubbed the "Umbrella" antenna, but found little favor with hams due to the large number of wires, insulators and ground anchors. The more wires the better was the motto. Some of these were still around during WWI.

which it was desired to work, results improved considerably. First 'full wave,' then half, later quarter-wave single horizontal wires came into being. Transmission lines or 'feeders' as they were initially termed, soon came within the scrutiny of the amateur. One of the earliest antenna systems using such a feeder system was the so-called "Zepp" antenna employing two wires, spaced by insulators, to supply rf power to the antenna. These were patterned after those used by the Germans on their Zeppelin dirigibles, hence the name, "Zepp" antenna. They proved very efficient in ham service and a large number are still in use today.

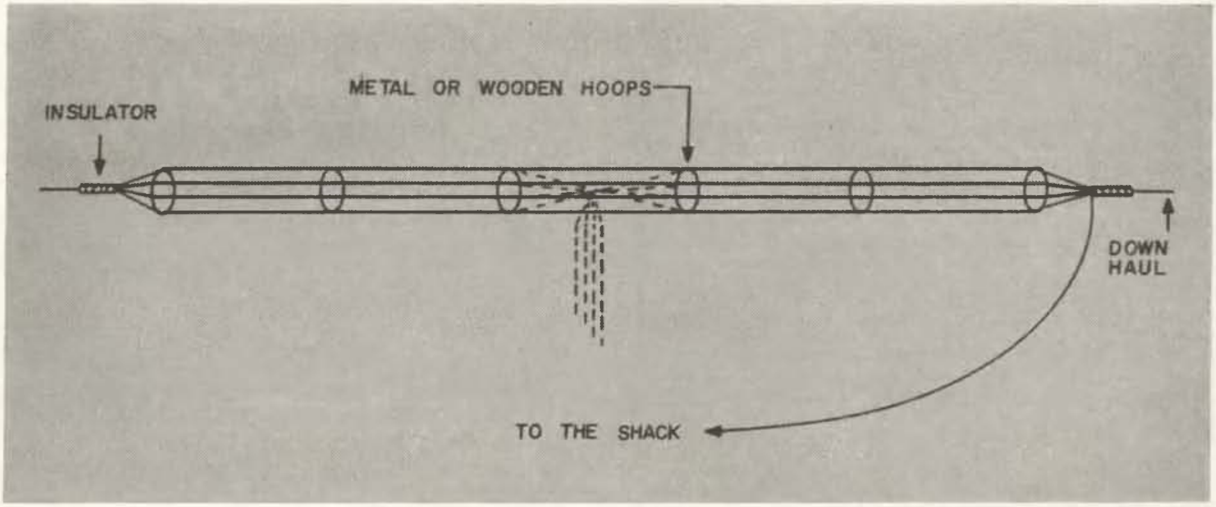
Equipment development had progressed meanwhile and unbelievable efficiency was being realized from both factory-built and 'home-brewed' transmitters. Thoughts again turned to antenna development both by the individual ham as well as manufacturers of amateur equipment. "Package" antennas soon appeared on the market; the radiating portion cut to proper length for the desired frequency band and insulators and similar accessory doodads supplied. To meet varying conditions, amateurs commenced to devise what were considered more or less as 'trick' antennas; descriptions of such with some pretty optimistic claims were appearing with increasing frequency in ham journals and handbooks. As a number of these had definite merit and lent themselves well to manufacturing production, a number of factories commenced fabrication.

It was not long before the problem of space in which to erect the popular horizontal wire antenna, preferably a half wave in length, became rather acute. Apartment dwellers and those living on small city lots were frequently unable to put up the length of span required by the then very popular 160 and 80 meter bands. Quarter wave antennas, calling for half the wire length, began to catch on and delivered rather well.

The eager and insatiable curiosity of the experimental ham was not so easily appeased however. Standard broadcast stations had discovered that a vertical tower with an insulated base, performed rather well for them. True, such towers were high and costly but their frequencies were relatively low in comparison to those used by the ham. Why not try it? A metal tower, mast or similar structure considered in the light of a half or even a quarter wave length in the ham bands, didn't seem too much of a problem. For the 80 meter band calling for some 130 feet for a half wave, a bit of structural as well as economic difficulty

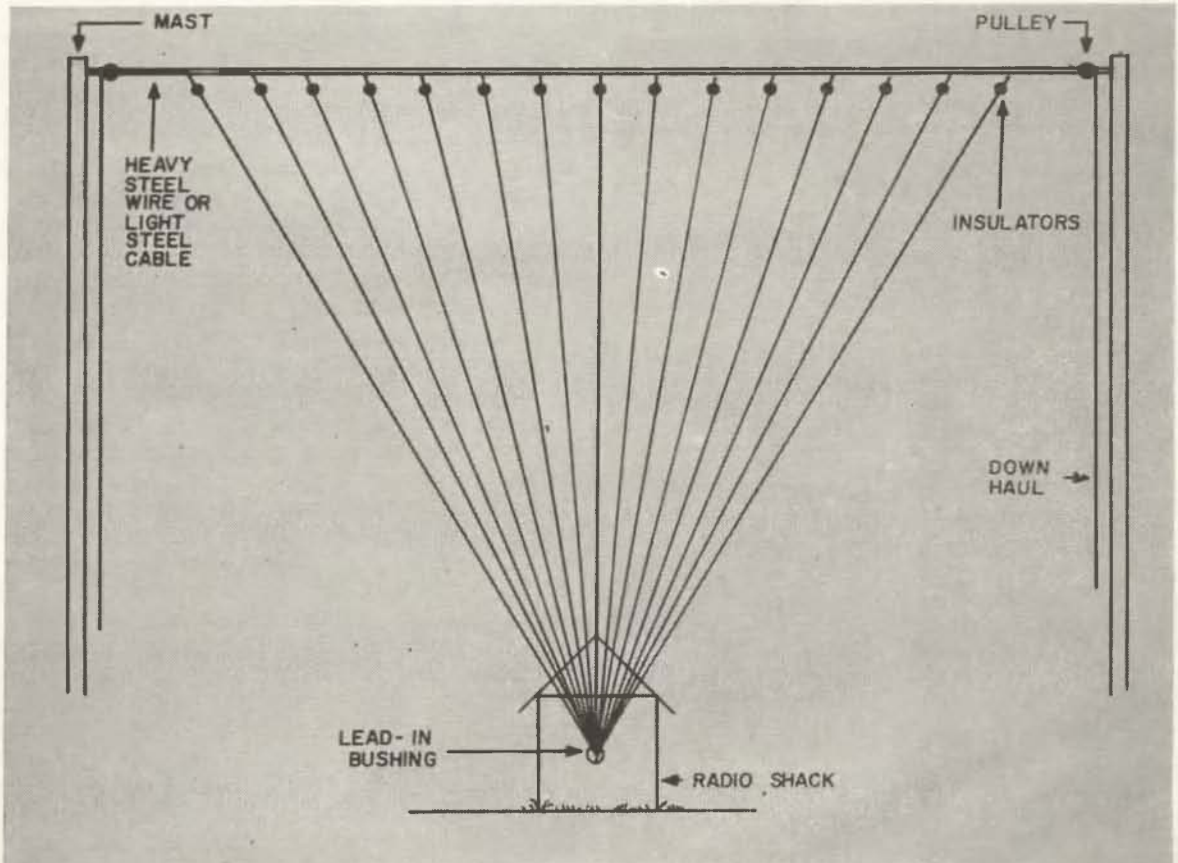


The most popular early day ham antenna, the Flat-Top was of random length. The wires were connected various ways, some put them in parallel, others in series, etc.



The Cage antenna was popular with hams just before WWI. Metal or wooden hoops from barrels were used as spreaders. When 1BCG put the first ham signal across the Atlantic in late 1921 using a "T" Cage antenna with a Cage lead-in this type immediately became popular. These were popular until someone discovered that a single wire was just as effective as the multi-wire system.

was naturally encountered. However, a *quarter* wave vertical radiator for the 80 meter band would only require *half* of this height or about 65 feet. Still a bit on the costly and structurally precarious side, but quite a few hams managed it and such antennas performed very well. For the 40 meter band, the problem was greatly lessened as a quarter wave there was only some 33 feet in height. The 65 foot structures for a quarter wave on 80 also performed well on 40; the 33 foot radiators used at a quarter wave length for 40, didn't do bad at all on 80, particularly with a base loading coil. Both heights showed good results on 20 as well. Hundreds were built and may be seen throughout the country today. Factories again took hold and as current advertising will indicate, it is possible to buy a commercially made



Vertical Fan antenna of post WWI vintage. It worked well, but was expensive. As many wires were used as you could afford . . . eight was par.

tower, mast or similar radiating structure in almost any practical height and within a wide range of prices. Many have refinements such as 'traps,' base or center 'load coils' and/or 'capacity hats' at the top.

Next in line came the 'antenna tuner' which had already demonstrated its value to a considerable extent in connection with horizontal antennas. Even more so was it desirable on the vertical type of radiator. A combination of inductance and capacity, properly proportioned and installed between the transmitter and the antenna, did the trick. Many hams built (and still do) their own antenna tuner (or coupler as it has been more correctly termed). Manufacturer again kept pace and there are today, a number of factory built antenna couplers available on the market.

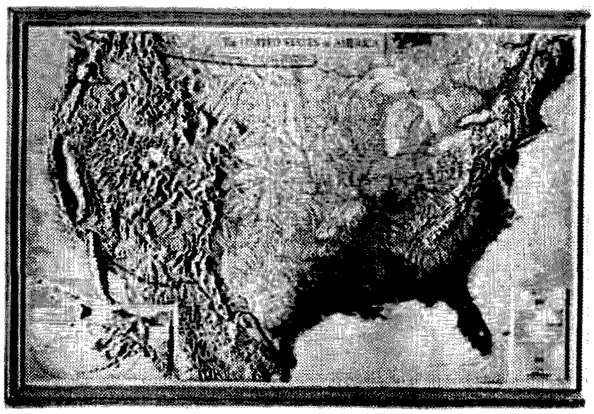
As operating frequencies increased to embrace the 15, 10 and 6 meter bands (and later even 2 meters), special antennas for these bands were devised. "Beaming" the signal for greatest radiation in the desired direction became highly popular; it proved phenomenal in working DX on these frequencies. Soon some of the more ambitious hams designed and erected such beams for use on 20 meters as well although their physical size became a bit awkward and unweildy. This problem was pretty well solved by ingenious design and it was not long before these too were being offered to the amateur market by a number of manufacturers. Rotation of these beams to the desired direction was initially accomplished manually; many hams used old auto steering wheels procured at wrecking yards. Not too bad either, fitted with a suitable pointer and a compass rose although they did offer quite a problem in the way of a watertight bearing through the roof! It wasn't long however before *electrical* rotators were fitted to the mast and rotation was then controlled from within the shack by a dial and pointer similar to those used on transmitters and receivers. Thousands of these electrically rotated beams are now in daily use throughout the world.

What next is anybody's guess. Today, in a fairly populous area, you can see practically all of the current types of popular ham antennas. Beams, in many respects, closely resemble conventional TV antennas. You can retty well tell by the physical size of them, which band the ham owner favors. Horizontal wire antennas are all more or less of the same general type; a half or a quarter wave horizontal wire between two supports; these may be fed in various ways but are all basically the same. A single wire feed as in the 'Windom' type; two open wires at the center, spaced throughout their length with insulators; the 'Zepp' with a similar pair of wires at one end; either center or end fed with coaxial cable or two-wire ribbon resembling TV lead-in. Even

(Turn to page 57)

SANDY CLAWS

would give you one of these if he could make 'em, but it takes huge machines to crank these precision moulded gems out. Give one to the XYL for Xmas, be a Dandy Sandy. Give one to the Jr op so he can put it up on your shack wall. But when you give it you don't have to let on about the free one year subscription to 73 (or extension) that we're sending. Now, about these maps . . . they're 28½" x 18½" and the mountains stick right up at you, all in the right places. This is not one of those cheap crumby maps either, it is an expensive uncrumby one with eight colors, all different. Send.



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Christmas Cheer and All That

While there is still considerable discussion going on as to whether subscriptions to 73 should be given to friends or to particularly despised enemies, there is no question about the fact that you should be giving them. Please fill out the below blanks and mail immediately. If we get 'em in time we'll send out a special Christmas gift card to the recipient which should arrive a day or two before the holiday which comes, I believe, sometime late in December. We'll start the sub with the January 1962 issue which will be mailed December 20th and should get there at about the same time.

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(Antennas from page 54)

the more modest random length wire with a similar single wire lead-in or down lead from one end or some random length along the antenna proper, will frequently be found.

And, the vertical antenna in popular use by thousands, will either be mounted on a roof top with appropriate guy wires or perhaps on the ground iteself. It may or may not be insulated at the base depending upon its feeder system; it may or may not have a 'capacity hat' of some sort at the top. Perhaps it's an elaborate tower, maybe only a simple mobile whip, roof or mast mounted. Water pipe, electrical conduit, rain-pipe and even a series of beer cans soldered together end to end, often serve as a radiator! Some are even a single wire suspended from a yard-arm and run down the pole on insulators; frequently copper tubing is used in this manner.

So, there you have it. Antennas have come a long way since the simple rods of Maxwell and Hertz and the 'stove pipes' of Marconi. What will *you* use? The choice is strictly yours and is dependent upon several factors. Available space, the band you want to work mostly and your checkbook. Talk to other hams; if they have been in the game any length of time at all they have no doubt tried a number of the more conventional antenna types. Find out what they think of those which they have used. Then make up your mind what you want to do; study antenna chapters in handbooks and read the many articles in the periodicals, check your bank balance and measure your available space, then go to it! "73" and 'happy hamming'! . . . W7OE

Letter

Dear Wayne,

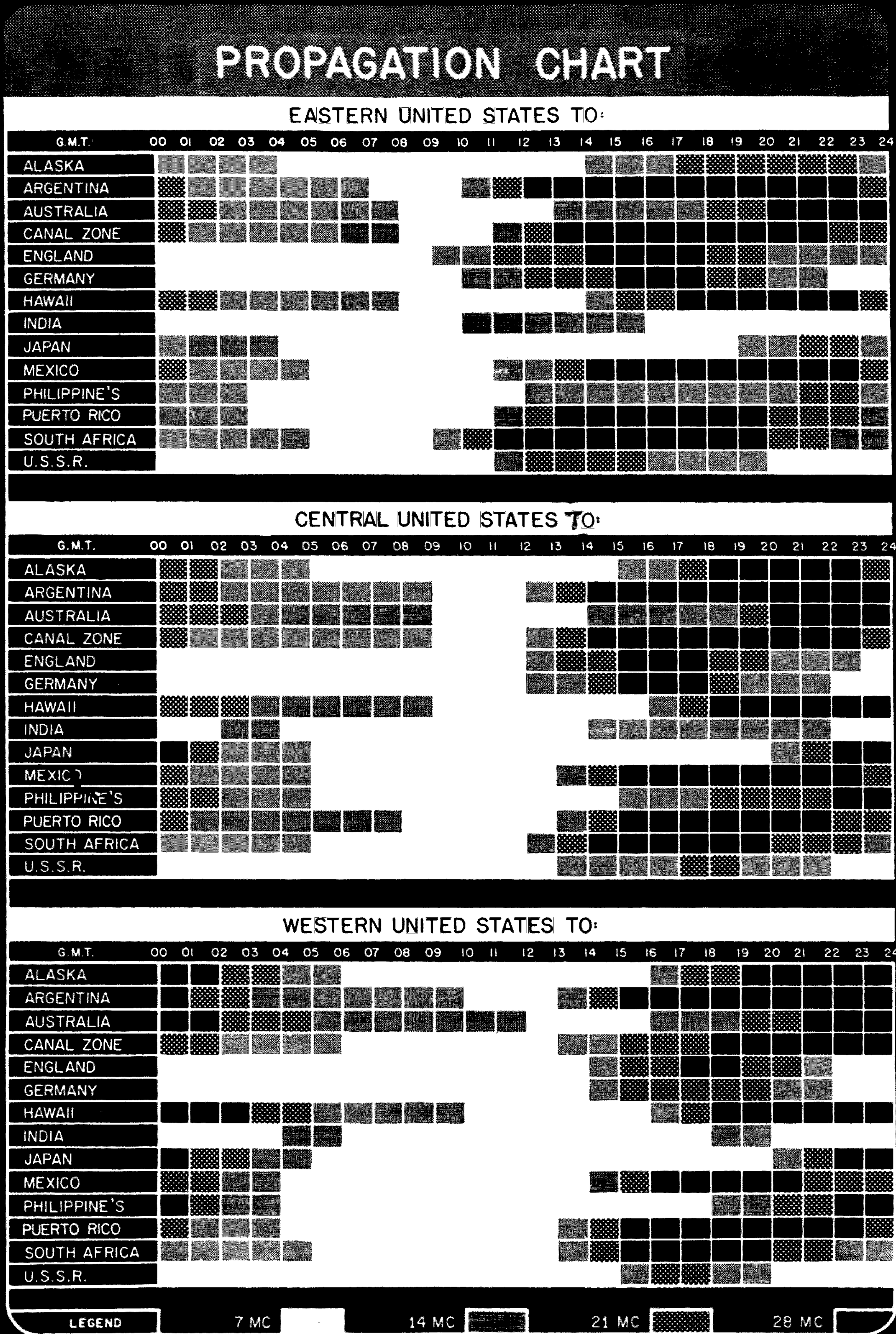
Please find enclosed a check for $5.00 to renew my subscription for the next 2 years; I feel that having survived the first year you should be worth risking 5 bucks for the next 2.

Having run the gamut from Neophyte to Novice to Technician and finally at long last to General during the first year of 73 Magazine I would like to say that without the help of its informative articles I could never have gotten my General Ticket. I would like to say this but of course you know that this would be a helluv an exaggeration and a damn lie. However, I must say in all sincerity that I have enjoyed your magazine immensely and while not finding every article of particular interest at the time I find myself frequently referring to these back issues of 73 for information.

Hope you keep the general format the same Wayne, with plenty of construction articles and leaving the club news and contests to the other magazines.

Continued good luck and success in the future to both you and 73 on its first anniversary.

Bob Tanner K3ONQ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U.S.S.R.
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PHILIPPINE'S
PUERTO RICO
SOUTH AFRICA
U.S.S.R.
LEGEND
7 MC
14 MC
21 MC
28 MC

Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

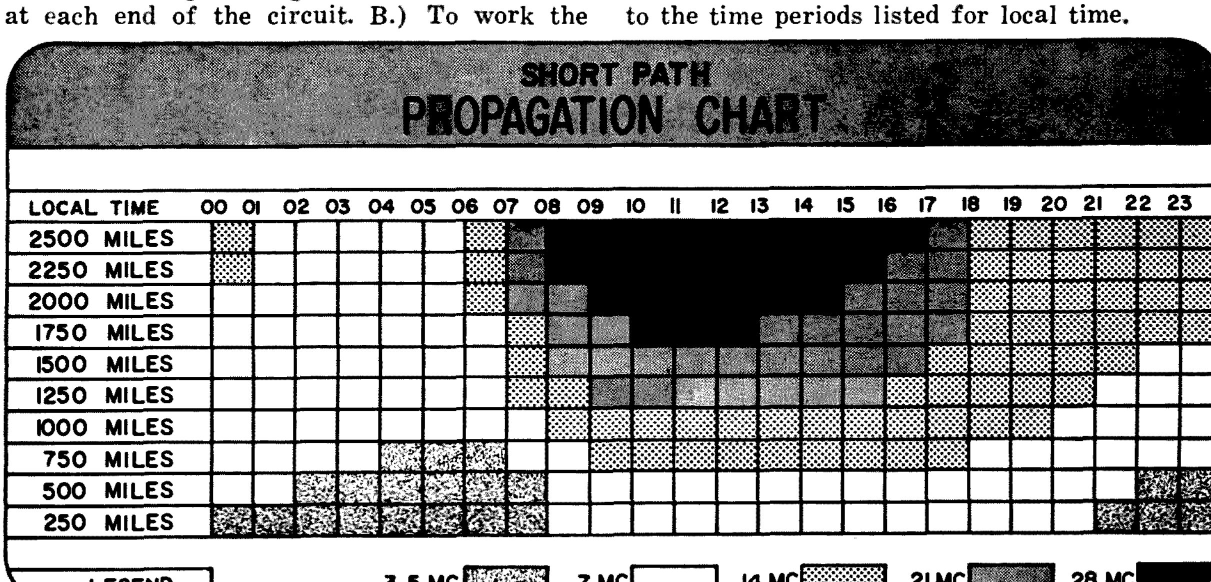
Advanced Forecast, November 1961

Good: 7-8, 10-25

Fair: 1-2, 6, 9, 26, 29-30

Bad: 3-5, 27-28

The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earth's curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HBF's next to the 1250 ile listings will give the HBF to use and the time periods given will be the same at each end of the circuit. B.) To work the path New York to San Francisco (2,600 miles), the local time centered on the mid-point of the path will be 1½ hours later than at San Francisco and 1½ hours earlier than in New York (the time difference between New York and San Francisco is 3 hours). Looking up the HBF's next to the 2,500 mile listings will give the HB to use. In San Francisco subtract 1½ hours from the time periods listed for local time and in New York add 1½ hours to the time periods listed for local time.



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Two Uses for a Birdie

Jim Kyle K5JKX/6
1851 Stanford Avenue
Santa Susana, Calif.

BIRDIES are familiar problems to nearly every VHF addict—and on occasion plague the rest of us as well, producing spurious signals at certain points within the tuning range of our receivers.

Those VHF men who have been forced for one reason or another to live with the birdies produced by their own pet converter-receiver combination usually have managed to find some use for them. One of the simplest is to use the birdie as a marker signal to ensure that the proper position for accurate frequency readout.

However, that's neither the kind of or use for a birdie we're going to discuss here. The particular genus under the spotlight today is the BFO birdie, that annoying whistle or tweet that may occasionally show up at multiples of your BFO frequency whenever the beat oscillator is turned on.

In case you don't recognize the term, incidentally, a birdie is a spurious signal produced by unwanted harmonics, their sum, and their difference. The difference between birdies and other spurious signals is that the name "birdie" is applied only to signals resulting from oscillators within the equipment. That is, the BFO and the receiver oscillator may produce birdies, as can the BFO alone. VHF birdies are usually caused by harmonics of the converter oscillator and the receiver oscillator, etc.

The usual cause of a BFO birdie is radiation of harmonics from beat-oscillator circuitry into the front-end portion of the receiver. These birdies can sometimes be heard as far up in the spectrum as 9.1 mc—which is the 20th harmonic of the signal. The cure, naturally, is to isolate the BFO to a greater extent through shielding, bypassing, and all other harmonic-reduction measures usually applied to a TVI-producing transmitter.

But this article isn't about the cure and defeating of BFO birdies—it's about two ways to make good use of them. If you don't have a birdie in *your* set, you'll have to put one in (temporarily only) to make use of these tricks.

Possibly the more useful of the tricks is the use of the birdie to determine the exact response frequency of the crystal in your crystal filter. With only a little care, you can locate this frequency accurate to ± 1 cycle or less. Here's how:

Disconnect the receiver's regular antenna and attach a short length of wire (insulated variety) to the BFO plate terminal. Route the other end of the wire into the front end portion of the receiver to let the birdies be picked up by radiation. Attach a VTVM to the second-detector load resistor, and turn on the set and the BFO.

With the crystal filter set to the OFF or equivalent position, tune in the neighborhood of the lowest multiple of your *if* frequency (910 KC, 1820 KC, 2275 KC, etc.) which you can reach. If your set tunes the BC band, the second harmonic is best at this point because it is the strongest.

When you find the birdie, set the crystal filter to its broadest position. While watching the VTVM, adjust in turn the BFO tuning and the receiver tuning until the VTVM indication reaches a peak at the same time the audio signal goes through zero beat. These two adjustments interact strongly, and this is the most critical part of the procedure, so take your time.

Now, without touching either adjustment, set the crystal filter to its sharpest position. You'll probably have to touch up the tuning adjustment to restore the VTVM peak reading. If an audio note is audible at the new peak reading, repeat the dual adjustments made in the previous step until the zero-beat and VTVM peaks coincide again.

Read the frequency from the receivers tuning dial and divide by the number of the harmonic used. That is, if the adjustment was made at the second harmonic, divide by two. If at the fourth harmonic, divide by four, etc.

At this stage, you know the crystal's response frequency only within 25 to 30 cycles, since the combined response of your ear and the receivers audio system cuts off at about 100 cycles. To check more closely, leave the

BFO adjustment alone and tune to successively higher harmonics with the tuning dial. At each birdie, zero-beat should coincide with the VTVM peak. If not, readjust the BFO ever so slightly. Remember, a 10-cycle adjustment monitored on the 20th harmonic will move the signal 200 cycles, which can well be outside the passband of the crystal filter in the sharp position. However, if you're on the nose at the 20th harmonic, you're within less than 5 cycles of the exact setting at the fundamental.

With the BFO adjusted exactly to the crystal response peak, it can now be used as a signal generator to align the receiver *if* stages for maximum performance at this frequency. Simply touch up each adjustment on each *if* transformer for maximum indication on the VTVM, taking care not to disturb the BFO setting. This simple procedure will frequently improve a receivers apparent gain by 10 times or more, since alignment is not permanent and an error of only a few cycles in each transformer adjustment can result in a large over-all loss of received signal.

The other use for a BFO birdie is as a substitute for an accurate 100-kc standard in calibration of equipment at frequencies other than the WWV standard transmissions. The BFO can be used to inject a signal every 450 kc or so, and this signal can be made accurate to approximately ± 10 cycles at the fundamental frequency. Here's how:

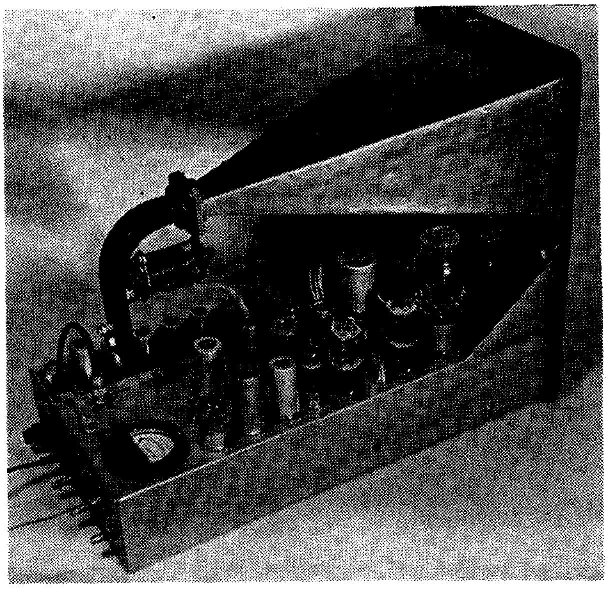
Set up the "birdie generator" antenna as described earlier and turn on the BFO. Tune the receiver to the broadcast band, and select a station in the 900-950 kc range.

Adjust the BFO setting until you get not one, but *two* beat notes. One will change pitch twice as rapidly as the other, and will be less strong; the fast-moving, weaker one is the one you're interested in. Ignore the strong one.

Continue adjusting the BFO until the weaker note is in zero-beat with the BC station. You have now adjusted the birdie to zero-beat, and the BFO is set to exactly (± the lower audio cutoff frequency mentioned earlier) one-half the frequency of the BC station.

Look up in a log the frequency of the BC station and divide by two. This will tell you the frequency to which the BFO is tuned. CAUTION: If you zero-beat the BFO with the birdie, instead of zeroing the birdie on the BC station, results will be inaccurate.

Now all you need to do is to tune to the third, 4th, 5th, etc., harmonics of this frequency and zero-beat the birdie *by adjusting the main tuning only* (don't move the BFO setting.) Zero-beat will mark the exact spot on the dial at which the harmonic falls, and pencil-and-paper calculations will tell you the virtually-exact frequency of the harmonic. With these checkpoints every 455 kc across the lower bands, it's not too difficult to interpolate other calibrations accurately.



Get That Last DB From Your Parabolic Dish

Horn Antennas

Erik Roy TI2NA
1616 Tibbits
Troy, New York

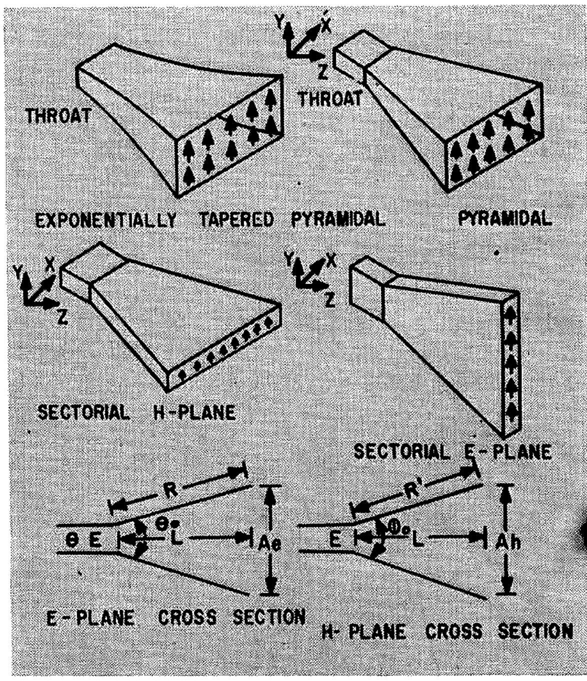
A HORN antenna can be used as a feed for a dish. If the dish is fed by a dipole or a dipole and a reflector it will not have optimum gain and bandwidth. It will be 2 to 4 db short of optimum gain, sometimes more. This extra gain doesn't come from the higher gain a horn has over the original feed, but it comes from the better illumination of the dish and the lack of side lobes and back lobe of the horn as a feed. With a dipole or a dipole and reflector, there is a back lobe and side lobes, all of which fall outside the dish, causing a loss in gain. In addition, spill over, which is caused when the beam width of the antenna illuminating the dish is greater than the angle of illumination of the dish, reduces the optimum gain. Sometimes the opposite can happen. This is very unusual and it happens when a poorly designed horn with too small a beam width is used.

Horns alone are not useful as antennas until the frequency is 10 cm or less because they are too large and cumbersome for the gain available. They are easy to design and build if you follow carefully the charts in this article. But before we do any constructing, a little theory may not do us any harm.

A rectangular horn with flare in both planes, as discussed in this article, is called a pyramidal horn. Other types include the exponentially tapered pyramid, sectorial H-plane and sectorial E-plane horns. (See Fig. 1)

To obtain as uniform an aperture distribution as possible a very long horn with a small flare angle is required. However, from a practical standpoint, the horn should be as short as possible. An optimum horn is between these extremes and has minimum beam width without excessive side lobes for a given length.

If the aperture in the two planes of a rectangular horn exceeds one wavelength, the pattern in one plane is almost independent of the aperture in the other. So, a horn can be designed as an antenna or as a feed for a parabolic antenna. The only frequency dependent parameters of a horn are the dimensions such as length which affects the gain and the type of waveguide feed at the throat. For the most uniform aperture illumination, the higher modes of transmission must be suppressed. Therefore, the width of the waveguide at the throat of the horn must be between ½ and 1 wavelength. If the excitation of the system is symmetrical, so that the even modes are not energized, the width must be between ½ and 3/2 wavelengths.



Figs. 1 and 2.

Referring to Fig. 2, the total flare angle in the E plane is Θ_o and the total flare angle in the H plane is Φ_o. The axial length of the horn from throat to aperture is L, and the radial length is R. A_e is the E plane aperture, and A_h is the H plane aperture.

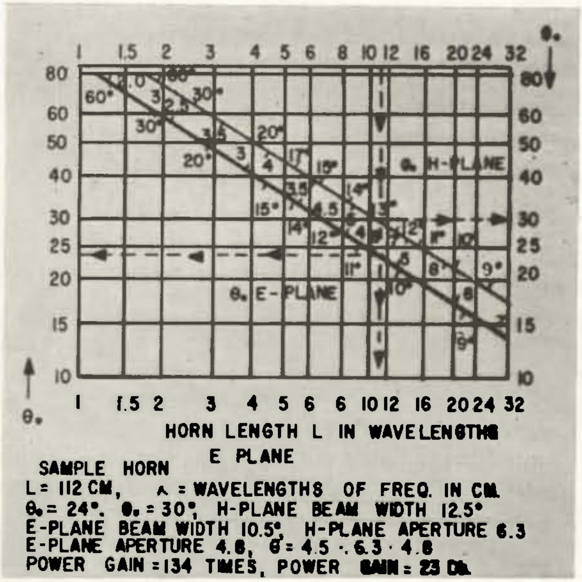


Fig. 3.

When building a horn, care should be taken so that the thrust fits the waveguide that feeds it. The corners don't have to be perfectly square, and, if the joints are made at the corners, they should be braced. If they are made on the middle of the H plane, they can be soldered because good conductivity is not necessary at this point as it is a voltage antinode. The chart in Fig. 3 is designed to give maximum gain which is needed in horns used as antennas.

When a horn is used as a feed for a parabola, the most important consideration is the illumination pattern. Therefore, if we know the feed angle necessary for feeding the parabolic reflector, a horn can be designed to do a fairly good job of illuminating it as the beam width of a horn is dependent to the aperture of its respective plane. For best results in feeding the parabola, the 10 db power points are used in figuring the horn. The chart in Fig. 4 gives this beam widths with respect to the other possible variables.

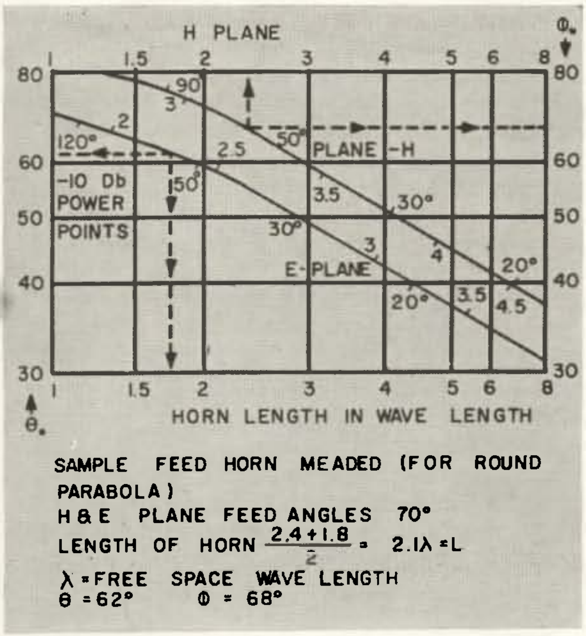


Fig. 4.

If the parabolic dish is round, the vertical and horizontal feed angles are equal. If it is another shape, oval, rectangular, etc., it has two separate feed angles. With equal or different feed angles, the design of the horn is simple if you have the chart in Fig. 4. A feed horn is not recommended if it figures out to be shorter than 1.5 wavelengths long. This is because the aperture illumination is not uniform and the side lobes tend to increase in strength. When the lengths are found in the chart, they may be different, so the average of the two Ls are taken as the length of the horn. If the difference is more than 2:1, the larger dimension should be taken as L. The thickness of the material is not critical and it should be a good conductor. A silver coating will help if the horn has been soldered.

A horn for 1296 mc is not difficult to build and the gain in performance will warrant the use of one as a feed for a parabolic dish. The one shown in the picture is a 10 kmc horn 11 wavelengths long with a measured gain of 22 db over a dipole.

. . . TI2NA

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Audio, Hither and Thither

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AFTER an absence of ten years from amateur radio (ten years absolutely wasted acquiring a wife and four kids) I again got the bug. As my code speed was run down at the key I settled for a Technicians ticket and promptly got on six meters with the aid of a Gonset G-50 and a friendly bank loan.

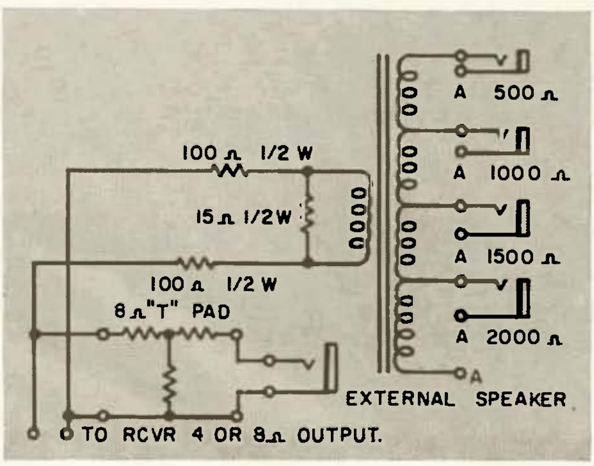
The fact that the G-50 did not have a phone jack suitable to my needs is where hereby hangs a tale. As much of my prior ham work had been on cw, I was used to headphones rather than a speaker and had to originate a headphone connection.

Referring to the diagram for UNIT #1 we see a speaker matching transformer with the four secondary impedances brought out on jacks. The low Z side of the transformer is fed from the G-50 external speaker jack. A new external speaker was added and its level is controlled with the Tee pad shown.

The fixed pad consisting of the two 100 ohm and one fifteen ohm resistors performs the following services. There is a certain amount of residual hum in the G-50 not apparent on the speaker but definitely audible on earphones. With this pad the audio volume control can be cranked up to obtain a good signal to hum ratio without lifting the cans off your ears.

Secondly, the pad provides just the right level to feed the receiver audio into my Revere tape recorder.

Notice that for reasons to be spelled out in just a bit, the jack feeding the new external speaker must NOT be grounded to the metal case the unit is built into. Putting it another way, there must be *no* dc connection between any part of the primary and secondary circuits of the matching transformer.



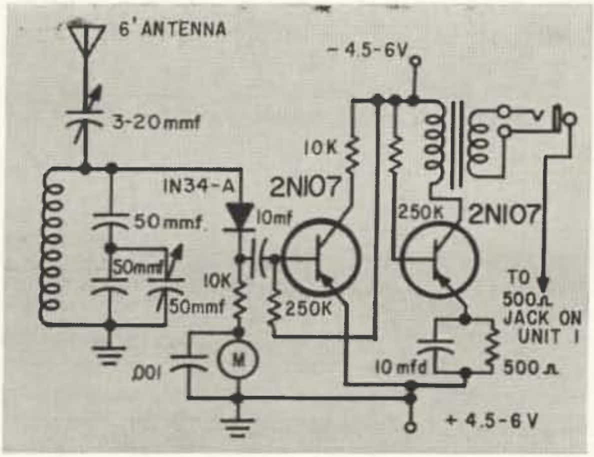
Now that I have established the fact that I own and use a tape recorder in connection with my shack to record QSO's and let the guy with the good audio (or bad) know just how he sounds, you can see a good reason for *no grounds* on the matching transformer secondary. By patching the audio from my tape recorder into the external speaker jack and patching the 500 ohm winding into my telephone I can play the tape back to any local ham who wants to hear his own signal. When it comes to a telephone, no grounds means no troubles which means good clean relations with Mother Bell.

There still semed to be a void in my life. When I recorded a QSO, my own glorious voice, my wonderful ideas and tremendous contributions to the general QRM never made the tape. In desperation was born Unit #2.

My QSO completer turned out to be a combination field strength meter, transistor radio and ego flatterer. Notice the charming simplicity of the little monster, born of a union of the junk box and the Lafayette Catalog.

Basically Unit #2 is a six meter tuned circuit, followed by a crystal detector feeding a two stage PNP transistor amplifier. The meter reads rectified crystal current providing an indication of signal strength. A pair of phones can be plugged into the output jack if you wish to use the unit to monitor your own signal. To use the unit as a QSO COMPLETER it works in conjunction with Unit #1 as follows. The audio from the transistor amplifier plugs into the 2000 ohm jack on Unit #1. The tape recorder is fed from the 500 ohm jack, thus the receiver audio and my own audio are combined on the tape, making a complete recording of the QSO. The 1500 ohm jack is used to feed my headphones.

Just one note for the boys who go to bed with their grid dip meters. Don't measure the tuned circuit out of the metal box as it will measure LOW. When installed in a metal box the tuning should be from about 49 to 55 megacycles. Tuning of the tank circuit will have more effect on the meter than it will have on the audio output, so for all practical purposes the variable condenser can be set to the middle of the band and forgotten. Use the antenna



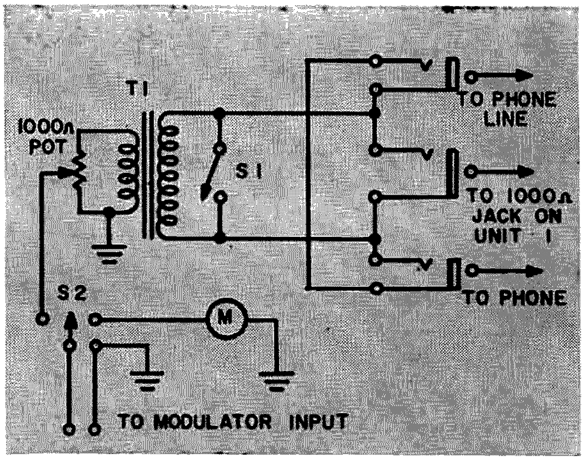
length to adjust for a convenient meter reading consistent with adequate audio output.

Having filled the void in my life I six metered it night and day, being fortunate in having an understanding wife . . . who is also weaker than I am. Then came cupid. A young gentleman in Pennsauken innocently asked me if I could phone patch him to his current lady love and thus provide him with entertainment while cutting the cost thereof of.

Being the possessor of a loving and gentle disposition I nevertheless had to deal cupid a dirty blow by answering negative. However, this did set me to thinking. I did have a phone. The phone bill was paid. I did have a means via Unit #1 of getting audio into the phone line. It was therefore up to the genie of the junk box to get audio out of the phone. Thus, because of purple passion, was born Unit #3.

Since we are going to attempt to deal with the telephone it is time for a few well chosen remarks. Somewhere inside your phone you will find three wires: Red, Green and Yellow. Red and Green are designated as L-1 and L-2. You have no need of the yellow wire as this is the ringing circuit which energizes the bell. One very important note: *do not place any grounds on any phone connections!* If you do, all kinds of loud and soft hums will ensue and the boys in the central office will be around to visit.

Now let's see how Unit #3 works. The row



of three jacks from top to bottom accept the incoming phone line—The audio from the 1000 ohm jack on Unit #1 and the phone instrument. The jacks are wired in *series* so that in effect the audio from Unit #1 is in series with one side of the phone line. With SW1 closed the phone works normally. With SW1 open two things occur. Audio from your receiver will go into the phone, and incoming talk from the remote phone may be switched into your transmitter via T-1.

T-1 is a single button carbon mike transformer wired with the high impedance side facing the phone equipment. The mike or low impedance side has a 1000 ohm pot across it to act as a patch level control for the incoming phone conversation to your rig.

SW-2 selects either the regular station mike or the phone audio to feed to your modulator. Naturally all leads at low level are run in shielded cable to avoid hum and rf feedback.

Now as to typical operation in normal use. SW-1 is left closed and SW-2 is set to the station mike position. You contact a ham who wishes you to phone patch. After dialing the number and reaching your party, you explain the principle of the phone patch. Friend ham is standing by so you contact him and say you are ready with the patch. At this juncture switch both SW-1 to its open position and SW-2 to the telephone position. This will put the telephone audio into your modulator. Let us assume that friend ham is to initiate the talk. You tell him to go ahead, kill your carrier and regulate his audio from your receiver so that the level in your phone receiver is comfortable to listen to. This generally works out to be good level to the remote phone without overloading the phone line and running the risk of cross-talk. Friend ham finishes his thought and says "Break." You switch your carrier on and the party at the remote phone speaks. You regulate the level to your modulator with the 1000 ohm pot as gain control.

While your carrier is on, you can interject your own comments by talking into your telephone, and both parties will hear you. In this regard you must watch out for overmodulation as you have the gain set for the remote phone which will be lower in level than your local phone.

If there should be any reason for cutting off the patch due to possible language which would violate FCC regulations merely throw SW-2 to the station mike position and explain your course of action to friend ham. You can ask him to stand by and talk to the party on the phone. If the patch is to be resumed with more cooperation and understanding, restore SW-2 to Patch and go ahead. If the phone call is at an end close SW-1 and hang up your phone. Finish your QSO and presto another patch is history.

Naturally, if you wish to, you can record the patch just as any other QSO as outlined earlier.

This patch is simple, effective, clean and foolproof. It has been duplicated by other hams with minor variations but always with success.

Just one final thought. A phone patch is an interesting aspect of amateur radio, just another way to serve the public and build good will for amateur radio. Don't abuse a good chance for public relations. . . . W3KBM

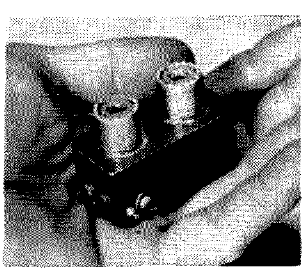
New Products

EICO CATALOG

Perhaps your tastes are jaded and you are insensitive to the lures of a well written catalog describing electronic kits. You would do well to develop yourself along this line for though it will inevitably result in a higher investment in electronic equipment, you will have a ot more to show for your years in the hobby. Now take the new EICO catalog (mention **73** when you do) and see if their seductive descriptions of ham, test and hi-fi gear don't get you busy at the workbench. EICO, 3300 Northern Blvd., L.I.C. I, N.Y. or mark your name in the service card in this issue.

Miller Catalog

The builders amongst us will get a lot of pleasure out of the new J. W. Miller catalog. It's for free and runs for 48 pages describing their complete line of RF chokes and transformers. Drop a line to: 5917 South Main Street, Los Angeles 3, California and ask for catalog 62. If you have any extra space on the card mention **73.**



Coax Switch

Bay-Roy has a new miniature coax switch available. This one isgreat for transceivers and mobile installations where size is of importance. Operates from 28 vdc, will handle 150 watts. Models are available in all common types of connectors. Bay-Roy, Box 7503, Cleveland 30, Ohio.

Ted Adams KØRRM
Box 26
Crescent, Iowa

Rewinding Relays and Transformers

THE first group we will discuss are the ac relays as most relays in use are ac 60 cycles.

Usually it will be found easier to supply the design voltage from a small transformer or directly from the line than to rewind the coil. Since this is not possible at all times it may be handy to note the following information. It is not practical to operate a dc type from ac directly. An ac relay is always constructed with a laminated pole piece and the armature is a solid strap or a laminated piece with a shading coil inserted. An ac relay will burn up if the armature is not in place, or if it fails to close when energized.

Coils are usually wound on a small paper or plastic spool which should be saved if at all possible. If not, a suitable one may be constructed of insulating paper and glued together. The most important consideration in winding is the number of turns of wire per volt of applied E.M.F. This varies considerably with the various types of relays, but usually is about 25-30 turns per volt for relays with a pole size of about ½ in. sq. The number of turns of wire on a relay may be easily determined by measuring the cross section area of the old coil and the size of the wire. The A.R.R.L. Handbook wire tables will give the number of turns. As can be seen from the above information a fellow would have a long white beard by the time he hand wound a 110 volt relay, but sometimes it is possible to mount the spool on a long bolt and chuck it up in a ¼ in. drill. The drill should be clamped in a vise and the wire supply mounted so the wire runs straight off the spool on to the coil. The wire may be guided lightly between the fingers and should be wound as evenly as possible. It is not usually necessary to layer wind relay coils, if good quality magnet wire is used. Formovar or enamel is usually best.

If the number of turns can be determined from the physical size of the original coil it is possible to find the number of turns for a different voltage quite easily by figuring the turns per volt. A coil designed for 110 vac is calculated to contain 2700 turns of #40 wire. This may be expressed as a fraction 2700 ÷ 110 and when reduced represents the number of turns per volt. Approximately 25 in this case. If the coil were to be rewound for 6 vac the number of turns would then be 150 and, as may be calculated from the wire table, #40 wire is rated to carry 14 ma, which would equal 38 ampere turns (product of ampere times turns). Thus it would be necessary to wind this coil with 150 turns of #28 wire to have the necessary operating energy required. This is found by dividing the number of ampere turns by the number of turns to be used in the new coil. In this case 38 ÷ 150 which gives 2 current of 250 ma. By referring to the wire table current carrying capacity list we find that #28 wire will handle 250 ma.

DC Relays

The dc relay is a much simpler and more dependable device than its ac counterpart. The dc relay may be made very sensitive and is easily adapted to any power source.

To rewind the coil of a dc relay the most important thing is the resistance of the coil. The coil must have enough resistance to limit the current to the current carrying capacity of the winding. The only other consideration is that the coil generate enough energy to overcome the armature tension spring.

The coil cross section area again may be used to approximate the number of turns in the original coil. The number of turns multiplied by the current will give the number of ampere turns necessary to operate the relay and the ampere turns may be converted to give the number of turns necessary for any given voltage.

The figuring of wire size and coil resistance could run into a complicated problem, so it was with a sigh of relief that I found that it is usually sufficient to compute the wire size and then wind the coil form full. The resistance of the coil may be checked and as long as it is high enough to limit current flow to the capacity of the wire, your coil will do the job ok. It is far better to have too much wire as it is easier to adjust the armature spring tension than to rewind the coil when it burns out. Of course if the coil resistance is so high that it is not possible to get dependable operation, a few turns may be stripped off quite easily.

Here is a very simple and useful way to compute the wire size to be used in rewinding a dc relay. Measure the resistance of the original coil with a good volt-ohm meter. This resistance divided into the operating voltage will give the current and this may be multiplied by the quotient of the original operating voltage divided by the voltage of the new coil.

This will give the current of the new coil and it is only necessary to refer to the current

carrying capacity section of the wire table to find the nearest size and wind the spool full as was stated before.

There is a good supply of 24-28 volt relays on the market. These may easily be wound for 6 or 12 volt dc. Some of the plate types have two coils wound seperately and connected in series. These coils may be paralleled and the relay will then operate as a 12 volt relay for the mobile rig.

Transformers

The rewinding procedure on a transformer is much like a relay. The transformer is disassembled, (the laminated core is removed) and positions of the various windings are determined.

Usually the filament winding of a power transformer is found to be the top or outer winding with the H.V. windings next and the primary winding is found on the bottom, adjacent to the core.

To rewind a transformer the turns per volt is again the most important factor to be considered. The small transformers used in radio gear and designed to operate on 120 volt 60 cycles will be found to have a ratio of from 6-10 turns per volt. If there is a filament winding to be removed from the transformer you are rewinding, simply count the turns as you remove them and divide the number of turns by the voltage. A 6.3 volt winding was found to have 44 turns of wire; the turns ratio would be 44 ÷ 6.3, or 7 turns per volt. If the transformer is to be rewound for 24 volts the number of turns would be 24 x 7 or 168 turns. It is possible to count the turns of the H. V. windings in the same manner, but the large number of turns takes more time than it is likely to be worth.

Entire transformers may be rewound using any good magnet wire, but enamel or formovar will usually be best.

As in all uses the wire must be of sufficient size to carry the necessary current. The necessary information may be found in the A.R.R.L. handbook tables. Care must also be used in order not to exceed the wattage rating of the transformer. If the rating is not to be found on the nameplate the load may be computed by totaling the individual winding rating—i.e. A transformer was to be wound for 12 volts, the original winding was found to be 6 volts at 10 amps and the original primary was to be retained. The wattage rating would be 6 x 10 or 60 watts, thus the current of the new secondary would be 60 ÷ 12 or 5 amps.

A final word deals with insulation. The enamel of Formovar on the wire is sufficient for turn to turn insulation, but layer to layer voltage will be too high for this insulation. The best insulation is regular transformer paper, but if the transformer is to be varnished or wax dipped, regular note or kraft paper may be used. . . . KΦRRM

The Fine Art of Surplus Utilization

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SINCE World War II, probably more words on the general subject of surplus have appeared in the amateur periodicals than on any other single subject. This is an opinion area and strong feelings, pro and con, are the rule. Individuals who have been severely burned are vehemently opposed to amateur use of surplus and those who have made fortunate acquisitions and used them intelligently are firmly entrenched on the other side of the fence.

The day is long past when surplus for the sake of surplus alone has any attraction for the average amateur. Aside from the questionable value of the nostalgic memories it evokes in the mind of the ex-GI, many items of surplus have no practical value and are probably best forgotten.

Military electronic surplus, of value to the amateur, falls in the following categories:

1. Equipment which may be put to immediate amateur use, requiring little or no modification, roughly equivalent to commercial equipment and available at substantially less cost than on the new equipment market.
2. Equipment which requires extensive modification or "conversion" to make it suitable for amateur use. A reasonable prospect should exist that the finished product will, at far less cost and labor, equal in performance and appearance a similar unit constructed from new commercial components.
3. Equipment of little or no value to the amateur as an end item but which contains one or more expensive or hard to get items for which an immediate requirement exists. To fall in the "good buy" class, the equipment should cost considerably less than the new cost of the required components.
4. Equipment of no value as an end item but so priced and containing such a quantity of modern components and hardware that it is worthwhile to strip for the salvage value of the parts. Be very cautious in dealing with this category of surplus. The cost should not exceed 10 to 20% of the new price for the expected yield of usable components.

Of course, as is true of all generalities, specific cases seldom fall precisely in a single category outlined above. In any surplus conversion, parts and hardware will be accrued and components expended. The main point is that a clear cut plan should exist for any item of surplus equipment purchased. All too much surplus equipment, representing funds that could have been better used in the purchase of commercial components or equipment, lies gathering dust for the lack of such a plan.

Before we enter into the actual mechanics of dealing with surplus, another aspect of the subject should be discussed. One fringe benefit derived from working with surplus military electronic equipment may not be apparent on first consideration. The technically inclined amateur usually attempts to pattern his construction projects to the highest standards with which he is familiar. This is where detailed knowledge of truly good equipment pays off.

If a construction project is based on standards derived from familiarity with $9.95 broadcast band "bloopers" and bargain basement "short wave" receivers, the results will probably leave much to be desired. If, on the other hand, construction standards are derived from a detailed knowledge of the design and construction techniques used in the best equipment, the project is off to an auspicious start.

This is not to imply that the design and construction details of all military surplus equipment are worthy of immediate amateur adoption. The reverse is often the case. Anyone who has worried through a number of surplus conversions knows that the biggest part of the job often lies in finding the best method of circumventing the intent of the equipment designer.

This, however, is not a matter of design but of application. The final electrical design and mechanical packaging of any item of military

electronic equipment is based on the intended use and probable environment. Assume two items of military radio equipment, electrically similar and functionally identical, one designed for use in fixed radio stations and the other for use in open combat vehicles. The first would probably be ideal for amateur use, while the second may be doomed to open storage in a surplus yard.

"Where should I buy surplus equipment?" is a question that is often asked. Despite the attractiveness of mail order surplus prices, purchase from a local dealer has many advantages. Local merchandise is available for inspection and condition is easy to determine. Also, a good price, swap or other deal is easier to arrange when you are bargaining in person. Further, if you only need certain components of an equipment, a favorable "strip on the spot" purchase is often possible.

Another argument for patronizing the local dealer is that all surplus houses sometimes have very desirable items in quantities too small to advertise. The best buys are often contained in these small lots.

Not to be ignored are transportation costs. Military electronic equipment is heavy, particularly when boxed for overseas shipment. It is not at all unusual for transportation costs to exceed the purchase price of the equipment. For example, to ship a 70 pound item of equipment 1500 miles, the charges would be about

Surplus from page 73)

$10.91 by Parcel Post, $11.19 by Railway Express and $7.40 by Motor Freight.

Once the purchase is made, you are truly committed. If the acquisition falls in the first category of commercial type equipment, your troubles are minor. No great difficulties should be encountered since the application will be much the same as the original intended use. If the instruction manual is not available, write a letter to the manufacturer. If this does not produce the required publication, contact the surplus dealers who specialize in such literature. Government sources of publications are more productive than is generally realized and details on this subject will be covered in a future article.

Surplus military equipment requiring "conversion" to meet amateur needs includes the bulk of available items. This equipment, falling in the second category, may or may not be applied as originally intended. Much equipment, for example the famous Q-Fiver application of the low frequency Command Set receiver, has its greatest value when used to satisfy a totally different need. Successful use of surplus equipment for conversion purposes requires that the following conditions be met:

1. A positive, individual requirement must exist for the equipment after the proposed conversion is accomplished.
2. There should be a reasonable prospect that the converted equipment will fully meet the minimum requirements.
3. There should be evidence that the proposed conversion is, in fact, the most economical approach to the problem. It goes without saying that the determination should be reached prior to the purchase of the surplus equipment.

There are, of course, other considerations than that of immediate practical application. If, as the writer, you get a great deal of pleasure and satisfaction in exploring the in-

tricacies of strange equipment and can afford it, as he can't, then more power to you. The sky is the limit and any practical return is pure gravy.

If you are following a published conversion plan or working from an already converted model that meets your requirements, then go ahead. If, on the other hand, you are treading new ground, a few general pointers are in order. Follow the philosophy of making the minimum required changes. Try, if at all possible, to keep the conversion completely self contained and within the confines of the original enclosure. Try to keep your workmanship to the same standards as those displayed in the construction of the equipment. There is rarely any real justification for haywire. Make an effort to bring all controls out to the front panel and strive for a convenient, symmetrical arrangement.

Perhaps the majority of available surplus equipment is designed for aircraft use. This equipment is usually housed in the black crackle finished, standard aircraft electronic equipment cases and is normally powered by the 28 volt dc and/or the 115 volt ac, 400 cycle aircraft power system.

Conversion of this type equipment to 115 volt, 60 cycle operation has been greatly simplified by the introduction of economical silicon rectifiers and the development of reliable, economical, high value electrolytic capacitors. Design and construction of these compact semiconductor power supplies for this application is a subject in itself which will be covered in a future article.

The aircraft equipment enclosures are fairly easy to deal with in these conversions. The ATR cases are usually finished in black crackle and this, despite the popularity of the thousand shades of gray, fits nicely in most decorative schemes. After all, we are dealing in communications equipment and as long as it presents a neat, functional appearance, this should be sufficient. If the finish is scuffed or abraded, a coat of gloss black, spray lacquer will restore the finish to its original condition. These pressure cans, spray lacquers, of which the Krylon line is representative, make equipment finishing easy.

The front panel of most aircraft radio equipment is formed to fit over the front edges of the case. Since it is highly improbable that the generous assortment of original connector holes would be used, it is best to provide a face panel to fit over the original. This finish panel may be a rectangular piece of 16 or thinner gauge aluminum cut to a slightly smaller size than the original panel. This panel may be finished in a matching or contrasting color and commercial decals applied for the professional touch. The control bushings and mounting hardware will usually be sufficient to hold the new panel in place.

(Turn to page 76)

(Surplus from page 75)

Once a surplus item of equipment is acquired, categories 3 and 4 become the same. The objective is to, by discriminating buying and careful salvage, accumulate a comprehensive stock of hardware and components. For the technically inclined amateur who does considerable experimenting and construction, this is indeed a lucrative area. Projects always start with an inventory of the junk box and the more complete the stock, the less the cost will be.

If you intend to obtain the maximum value from your salvage components, you had best abandon the junk box concept. Adequate, segregated storage facilities are essential if your parts accumulation is at all extensive. Small parts storage bin units such as the parts jobbers use are ideal for the purpose although expensive. The compartmented drawers will protect the parts from damage and enable you to find parts as you need them. The same considerations apply to hardware storage.

If funds are a problem, you might consider fabrication of your own storage facilities. Glass baby food bottles are easy to secure and will hold a fair amount of hardware and small parts. If your shop is located in the basement or an unfinished room, shelving may be made for them from 1" x 4" pine and installed between the wall studs. Shelves should be spaced slightly farther apart than the height of the bottles and the units fitted with Masonite or plywood backs. Molding applied over the studs and the edges of the shelving makes a professional job of your storage wall. A wall space, 4' x 6', will store over 600 bottles.

The actual stripping operation should be orderly and logical, using the scalpel rather than the sledge-hammer technique. Open up the cable lacing and clip the wiring leads a few inches back from the component terminals. This will give you a handle to work with in the clean up operation. Lead mounted components should be carefully unsoldered and the leads uncrimped with long nose pliers or one of the available unsoldering tools. As the components are freed of the wiring, dismount and lay

them aside. When the job is completed, survey the chassis, enclosure and the less likely of the components. There will be some items that could be of no future value. Ruthlessly dispose of these immediately.

During the stripping operation, be on the watch for subassemblies that are of possible "as is" use. Dismount these and leave them intact. Store them separately along with any special mounting hardware.

All components should be cleaned up before storing them. An electric solder pot is ideal for this purpose. The terminals of the parts may be immersed in the molten solder and the leads worked loose. Discard the wiring and when it is all removed, straighten the terminals and the leads of lead mounted components. As a final step, dip the leads or terminals in non-corrosive soldering flux and immerse in the molten solder. Flick the parts or drop them on the bench to remove the excess solder. If the solder pot is not available, place a regular soldering iron in a stand or clamp it so that the tip is accessible and both hands are free. It will take a bit longer but the results will be the same. The appearance of the parts may still leave something to be desired. If so, a thorough washing in alcohol will remove accumulated dirt and resin.

Inspect the parts and give them an ohmmeter check, discarding those that did not survive the ordeal. Segregate and stock as you would new parts. While there is work involved, and lots of it, very substantial savings can be made in the salvage of surplus electronic equipment.

The availability of military surplus electronic equipment is a definite asset to the amateur fraternity. Judiciously purchased and intelligently applied, it can save the technically inclined amateur much money, broaden his experience and increase his technical competence.

. . . W4WKM

(W2NSD from page 4)

attend the dinner and be charged $19 more. "Sorry, we don't have a seat for you up front here, these are all reserved. See if you can find one in the back somewhere." As you can guess, his name was not brought up when congratulations were being modestly exchanged on the podium for the success of the convention. Ass, what therapy an editorial page is for a grumbling editor.

It is nice as part of the exhibit area, to have a few booths allocated to the special interest in our hobby. For instance you might have a VHF booth, with a place for the fellows to post their QSLs and confab. You might also have a DX booth, and a sideband booth. If you can arrange special badges or buttons for these chaps they will wear them prominently. Most areas have a group of RTTY'ers that

(Turn to page 78)

(W2NSD from page 77)

will turn out in force if recognized.

Conventions can be a lot of fun if properly planned. I've been to many that I'll not forget, some with pleasure.

No Postcard

A call from our postoffice in Norwalk requested that we omit the postcard from this issue pending an investigation brought on by "some publisher" in New York City who had questioned whether it was strictly according to postal regulations or not. They couldn't enlighten me as to what the problem might be, so we're all in the dark until further word comes from Washington. A great many magazines now use inquiry cards these days so this might have rather widespread repercussions. Until we hear further we'll have to leave out the card . . . sob!

Last Will

A small ad in the *New York Times* auction section was the first word that I had of the demise of John Williams W2BFD. There was a small note saying that there was to be an auction of his equipment a few days hence.

All you fellows who have been hearing so much about ham Teletype should know that John had a large hand in its popularity. He started working with it right after the war and fanned interest in a handful of locals. From there it spread to several thousand who are busy with it today. I first heard the strange signals on the high end of two meters back in 1948 when I was Chief Cameraman for WPIX (TV) and had my two meter station installed on the top of the News Building on 42nd Street in Manhattan. I worked out magnificently from there with my 16 element and five element beams. There is nothing like a tall building to give one's signal stature.

So there were those tweedle-tweedle noises. I asked around about it until I ran into Bill Knott W2QGH, who explained all. I contacted John and soon was frequenting his small radio service store in Queens. After a while I had converted an armload of cash into an old Model 12 printer and a duplicate of the W2BFD RTTY converter, complete with auto-start, etc. I went on to full tape gear, the works. And I had a ball. We were restricted to two meters at that time, plus eleven. Cn the other ham bands we had to use make-break keying, which was not very efficient. The best I did was get an envelope of "copy" from Bob Weitbrecht W6NRM, another important pioneer TT man. I ran tests on 80M make-break too, but never worked very far due to the poor performance of make-break reception of RTTY through interference.

John spent most of his time in the back of

his radio store playing with electronic gadgets. He built the most amazing things. He insulated himself from the world with an automatic telephone answering system, and few people have managed to get past this for the last few years. He continued to round up Teletype equipment whenever he could and passed it along to the boys. When he died he had a tremendous collection of stuff. In addition to his regular store he also had at least three other stores full of RTTY and other gear, piled to the rafters. In one store I saw 1,500 Teletype keyboards.

When John died he left no hint to his surviving daughter as to how to get rid of this hoard. She didn't know which way to turn. She finally called in an auctioneer from Canal Street in New York. I drove over through the hurricane to see the auction and was amazed to find only a handful of people there, mostly keeping out of the rain, while this auctioneer quickly rattled off one lot after another to a junk dealer (electronic junk) who I understand is in the same building as the auctioneer. It took a while before I managed to get in some bids for at every opportunity the auctioneer would award a lot to his friend. I was appaled to watch hundreds of dollars worth of equipment being sold for $3 and $5. I started bidding in earnest. They still got a lot of bids past me by fast maneuvering, but I ended up with a few pieces that I was glad to have saved.

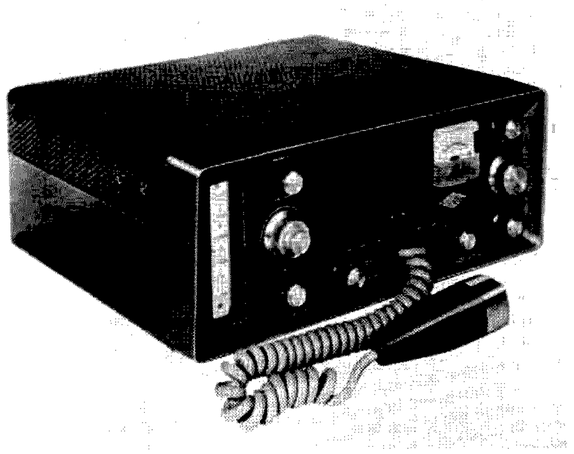
All in all I think I watched about $100,000 worth of electronic gear get sold for about $1,500. Those keyboards went for $75 total! I gritted my teeth because I don't have any place to put 1,500 keyboards.

The moral? Sit down fellows and make up a list of what you have, about what it is worth and put down some suggestions for your heirs to use when they are faced with liquidating your empire.

U.S.S.R.

One of our readers, Lee Gunther W6THN/1, who is also publisher of the International Ham Hop Newsletter, paid for a subscription to 73 for UB5UG. A recent letter from Yuri thanked him very much for the gift and explained that the magazine is thoroughly read and enjoyed by just about every ham in Kiev, with photocopies being sent to other cities. Unfortunately they are unable to subscribe since they cannot send out money, IRC coupons, or even postage stamps.

Perhaps you know some hams in Russia that would like to get 73. It costs us a little over two dollars per year in postage to send copies out of the States. As a gesture toward international friendship we'll send two subscriptions to Russian hams for you for the price of one. You send $4.00 and the name, call and QTH for two Russian hams. This is a temporary offer and will be voided if you start russia'ing us toward bankruptcy or if I get a sudden flash of business accumen.



Charles E. Spitz W4API
Associate Editor

73 Tests

The Gonset Communicator IV

IN THESE parts the Gonset Communicator is known as a "Gooney Box." This is said as affectionately as the famous "Gooney Bird" C-47 of World War II fame. Reliable and trustworthy, regardless of the operator.

In fact operating ease is one of the oustanding characteristics of the Communicator IV, yet with a technical perfection usually ascribed to fine custom made VHF equipment. Amateur radio, whatever the mode of transmission, passed through the stages of breadboard construction, six foot racks with glowing "jugs," the table top set of matched cabinets, and now is concentrating upon portable integrated equipment which can match the performance known previously only to fixed station operation.

Portable equipment has been with us longer than most people appreciate. The writer had the dubious pleasure of field operating the heavy wood cased single VT-1 tube, battery powered, portable at Ft. Monmouth when it was a military operational radio. For a long time we have come to accept many limitations in portable gear, attributing peak performance to the weight and bulk of fixed station equipment. I am happy to report that the Communicator IV packs in its 21.8 lbs all of the refinements of fixed station performance on 2 meters, and is a proponent of the modern trend where you can use it at home or take it with you.

Although the Communicator IV functions as a transceiver in convenience and operating ease, it is essentially a separate transmitter and receiver in the small cabinet. The only part common to transmit and receive is the audio system. Although it is a 20 watt transmitter, it seems to have more "punch," which can be attributed to the fact that there is 10 watts of audio modulation provided, with high level speech clipping instead of the commonly used screen modulation system. This means a peak power of 80 watts rather than a possible 20 using the rf system limits. The receiver sensitivity of better than one microvolt and a triple conversion super heterodyne winds up with very credible performance indeed, better than many fixed stations can boast. When you add to these characteristics an *ac and dc mobile power supply as an integral part* within the cabinet dimensions of 5" high, 12½" wide and 11" deep, you begin to appreciate the compactness of the system.

No external gadgets, plugs, relays, meters, inter-connecting cables, etc., are necessary for functional operation. You merely plug in the appropriate power cord for 110 v. ac, or 12 v. dc, the antenna, then load and talk. The slide rule dial is illuminated, and is driven by a dual ratio planteary drive knob. The illuminated self contained meter reads either rf output, facilitating antenna loading, or in "S" units for relative receive strength readings. There are no transmitter intermediate stage tuning controls, and the six crystal sockets in the rear provide ample frequency selection for average operation. Incidentally, the spotting switch which shows your transmit frequency on the receiver dial and "S" meter, serves as a good indication of crystal activity in case you are in doubt as to the merit of your surplus crystals.

Although there is no means of receiving sideband or cw, it is said a bfo conversion kit may be offered as an optional accessory

later. However, the writer was able to obtain a beat by turning on the spotting switch using appropriate crystals to receive both ssb and cw. This is a crude method, of course, and a matter of accident so far as available frequencies are concerned, but perhaps the new Model 3357 matching VFO may be used for this purpose in the interim, pending the bfo conversion, for those who desire it.

Transmitter RF Section

The rf stages use three 12BY7's, one of which normally functions as a crystal oscillator-tripler, where 8 mc crystals or a VFO of that frequency is connected to one of the crystal sockets. However, 6 mc crystals or VFO with a 6 mc output, or a VFO with a 24 mc output may also be used. The output of this stage is at 24 mc. This is tripled to 72 mc in the following stage, then doubled in the third to 144 mc, permitting the 6360 dual triode to operate "straight through" as a final amplifier with its 20 watts input for high efficiency operation. All of the coils are peaked at a point within the band where the output of each stage is equal at each band edge. In this manner, there is sufficient drive for the final amplifier over the entire band without the necessity for panel tuning or trimming, with the exception of the final. Conventional final plate condenser tuning is used in conjunction with a link-series condenser combination which results in less interaction between the two controls than a pi network. This method permits a more rapid frequency change yet maintaining some loading while tuning. Only the final tuning and loading control, in conjunction with the rf output meter, is used when changing frequency once another crystal or VFO setting is made. For most frequency changes, this is a minor trimming.

An rf wattmeter in series with the antenna indicates the Communicator meter as being sufficiently accurate and responsive in order to obtain maximum output. Although the output is 50 to 75 ohms impedance, it was possible to load an unmatched antenna. However, it is recommended that the antenna impedance be determined since the meter understandably re-

(See our ad on page 6, March, 73 Mag.)

sponds only to rf voltage. A mismatch of higher rf voltage could be misleading if it were to be construed to indicate a greater output.

Audio Section

On one transmission I rambled through a long dissertation, only to have one of the fellows who watched me on a 'scope tell me to turn up the gain, since I appeared to be under-modulated. This caused a search for a gain control, since none appears on the front panel. The old Communicators had one in the rear. After a fruitless search, the schematic diagram was spread out.

The boys were really impressed, as was I, to find none in the circuit. In my customary SSB operation, wandering from the mike merely means a not very noticeable lesser output. Here I had failed to take into account a basic design feature. The gain level and Astatic 331-18 ceramic microphone design has been set for mobile and field use where close talking is essential to the reduction of background noise. Close talking brought the modulation level back to 100%.

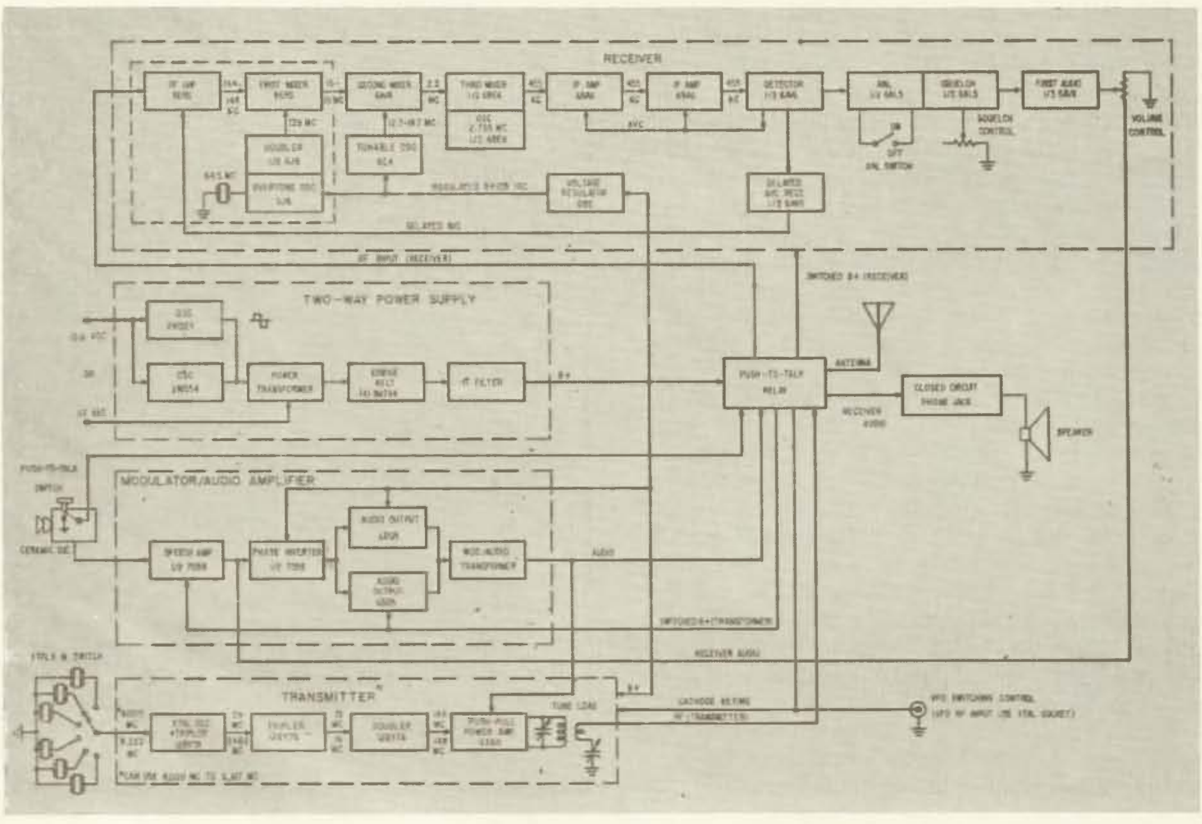
The pentode section of a 7059 is used as a speech amplifier, with its triode section as a phase inverter feeding a pair of 6BQ5's in pushpull. This provides 10 watts of Class AB_1 audio to plate modulate the 6360. The 7059 and 6BQ5 tubes serve a dual function as both receiver audio and transmitter speech and modulator. The microphone employs a push-to-talk switch which I personally prefer to VOX. It operates an internal relay which changes the antenna from transmit to receive, B plus from receiver to modulator, disconnects the speaker and keys the transmitter.

Receiver Section

There are a number of outstanding features in this receiver, to the degree that it is difficult to pinpoint that which is the most outstanding feature. Certainly the fact that the receiver handles like a first class communications set does on the lower frequencies, yet operates within the 2 meter band with such performance, does indicate something out of the ordinary. When this is coupled with a simplified control system, as it has to be for the non-technical users of Civil Defense and the Civil Air Patrol, yet retains the features desired by critical amateur radio users and is compared with meticulously custom designed VHF gear, that is something!

The receiver is a triple super heterodyne, thus giving excellent selectivity and freedom from annoying images. The antenna feeds a 6ER5 frame grid rf amplifier designed for low-noise. Stability is achieved through use of a 6J6 oscillator using an overtone crystal, operating at 64.5 mc and multiplying to 129 mc for injection into the first mixer, another frame grid 6ER5. The second oscillator, a 6C4, is tunable over the frequency range of 12.7 mc to 16.7 mc, and combines with the first *if* frequency of 15 to 19 mc in the second mixer, a 6AV6, resulting in a fixed frequency output of 2.3 mc.

The 2.3 mc second *if* is coupled through a double-tuned bandpass transformer to the third mixer, a 6BE6, where it is heterodyned



Specifications

Size: 5" x 12½" x 11" deep

Weight: 21.8 lbs.

Power: At 117 v. AC
Receive 87.5 watts
Transmit 110 watts
At 12.6 v. DC
Receive 7.2 amps
Transmit 10.3 amps

Tubes: 18 plus 2 power transistors and 5 silicon diodes, including dual and triple purpose tubes.

Transmitter: 6 or 8 mc xtals; 6, 8, or 24 mc VFO 20 watts input, high level modulation RF Output Meter

Receiver: Triple conversion super-heterodyne Squelch; noise limiter "S" meter
Sensitivity, 1.0 uv for 10 db S + N/N ratio
Noise figure, 3 to 5 db
Selectivity, from BW 6 db at 8.5 kc to 60 db at 47 kc
Tunes 143.7 mc to 148.3 mc (CAP & MARS)

Price: Model 3341 Transmitter-Receiver $369.50
Universal Mounting Kit Model 3365 .... $ 3.95
Telescoping Antenna Model 3152 .... $ 3.95
Carrying Bag (Blue) .... $ 12.00

against a 2755 kc oscillator to produce the 455 kc third *if* signal. Two stages of *if* amplification, using 6BA6's, are employed at 455 kc. Six tuned circuits produce the desired selectivity.

A vacuum diode (⅓ of the 6AV6), is used as the detector. This same tube is used as a delayed AVC rectifier, furnishing delayed AVC to the rf amplifier. One-half of a 6AL5 is used as a highly effective automatic noise limiter, switched in or out by a front panel control. The other half of the 6AL5 is used for squelch operation to permit muting of the background noise in the absence of a signal. The first audio amplifier is the triode section of the 6AV6. This audio is then fed into the 7059 which is employed as a speech amplifier when transmitting, thence to the 6BQ5's. An audio jack is provided on the rear apron for an external speaker or headphones.

The squelch range of 0.1 uv to 50 uv introduced the writer to an innovation for tuning in local stations. There is a fair amount of background noise at the site at which the equipment was put through its paces. A relief from noise in the hours of listening throughout the band was provided by setting the squelch to just override the fairly uniform background noise, then the fast tuning knob of the receiver could be rapidly rotated for band scanning with stations "popping in" out of the

silence as they were tuned in.

One of my first QSO's was with two stations who were complaining about QRM. This was news to me, because I could not hear any QRM on the frequency due to the receiver selectivity. As received from the factory, the receiver bandpass is broader than the maximum selectivity than can be achieved. This is because of OCDM requirements, when used for Civil Defense. It is 6 db at 10.3 kc, 20 db at 15.5 kc, and 60 db at 47 kc. For most amateur areas, this is plenty good and facilitates easy tuning. If you are faced with a QRM situation, three 2 mmfd QC type coupling capacitors on the 455 kc *if* transformers can be removed with a pair of diagonal cutters. No readjustment of the *if* transformers is necessary, and the selectivity curve will start at 8.5 kc instead of 10.3 kc.

Power Supply

I wish all the rest of my gear in the hamshack had supplies like it. It is a universal supply, using a single power transformer for 110 v. ac, or 12 v. dc. The changeover is made by plugging in the appropriate power cord so that switching is automatically done. The filter and four silicon diodes, 1N1763 types, are arranged in a bridge for both modes of operation. One transformer winding is for 110 v. ac. The primary and feedback windings utilized by the 12 v. dc source employ two 2N1554 transistors.

Accessories

This is usually an important part of the game when it concerns any major piece of equipment. The Communicator IV is remarkably free from the need for accessories for any normal operation. You can operate it on a desert island if you have 110 volts of ac, or 12 volts of dc, a crystal, and a 19 inch piece of wire to insert in the rf plug in the rear. You could do better with a good antenna, of course. In fact there is no limit as to how good the antenna could be. A minimum starting point should be at least a 5 element Yagi. Do the best you can, and it will do justice to the equipment.

The shape of the cabinet lends itself to convenient mobile operation. The Mounting Kit Model 3365 is inexpensive and is designed for the job. There are times when a telescoping set mounted antenna for portable use would be invaluable. The Model 3152 Telescoping Antenna is used for both the 2 meter Communicator IV and the Communicator IV-220, the latter being a 220 mc job.

The carrying bag, Model 3363, was designed primarily for Civil Air Patrol or Civil Defense use. It is a darn good item for amateur portable use also, and much more reasonable in price than a fitted case. The Communicator IV tested has a permanently fastened microphone, and these are available at distributors. There has been a demand for a detachable microphone and jack, rather than the permanently fastened system, which is to be produced. For these sets, the Turner Model 350 microphone, Gonset part number 113-021 has been recommended, although your old favorite may do the trick for you.

The equipment has been put through all its paces with many hours of continuous operation. This report has been as objective as possible with an attempt to reduce to the minimum the reviewer's own personal preferences. It is hoped the manufacturer will smooth out the irregular rim on the rear dust cover. This resulted in a slight wrist cut when unpacking and could conceivably happen again in handling. A BFO for CW and SSB reception would bring forth many voters. So would CW keying. These things are relatively minor, and can be set up by the user as well as the manufacturer.

The specifications are pretty severe for gear of this type, frequency and price range. The quality control, sometimes a greater factor than design engineering in the end, appeared to be very good as is the design. It is difficult to produce production equipment for the higher frequencies where there are so many advanced amateur specialists and yet meet their approval. However, few will quarrel with these specifications, purpose and overall quality of the equipment.

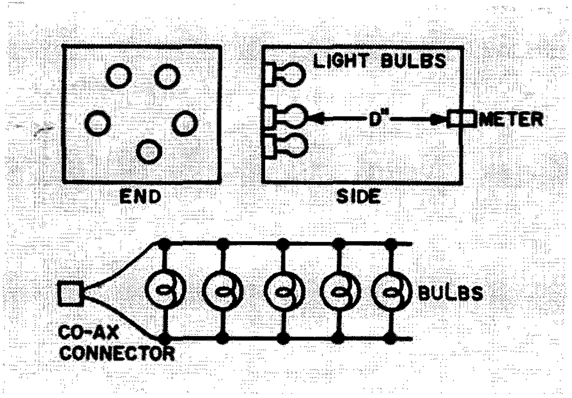
For the non specialist, and one who has had most of his operating experience on the lower frequencies, he will be agreeably surprised with the dependable and familiar communications receiver type of operation, as here is no haywire. There is a freedom from the headache producing QRM of the lower frequencies and an opportunity to meet people who are closer to you. Many on VHF also operate on the lower frequency bands and have common interests. VHF is still on the fringe of amateur frontiers, and the Communicator IV is a better tool.

RF Output Indicator

John Wilson

THE question of how much power a transmitter is putting out is one that often arises. There are a number of devices on the market which measure rf output, but most of them are pretty expensive. The device explained in this article will measure rf output in watts and should cost less than 10 dollars to construct . . . or almost nothing if you have a light meter.

This unit operates by measuring the amount of light given off by a dummy load consisting of five 20 watt light bulbs. The unit is designed



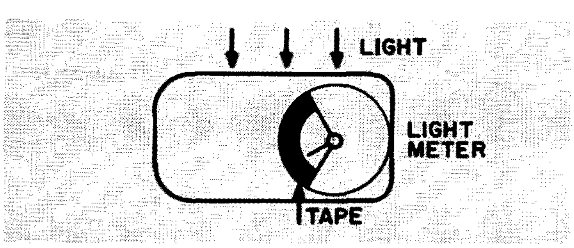
to measure rf output in the 0-1000 watt range.

This unit can be housed in any wooden or steel box of suitable dimensions. The original unit was housed in an 8" x 10" x 6" wooden box. The inside of the box should be painted black to cut down reflection.

The bulbs are placed in a pentagon configuration so that each bulb will concentrate the same amount of light on the meter.

Once the bulbs have been mounted, the calibration of the unit is simple. Temporarily connect the bulbs to a 115 volt source. Mount the lightmeter at a distance from the bulbs that gives full scale deflection. Place masking tape on the light meter scale and mark the position of the deflected needle 100 watts. Remove one 20 watt bulb and mark the new meter position 80 watts. Remove another 20 watt bulb and label the new needle position 60 watts. Continue calibrations to the last light bulb.

Now connect the light bulbs to a connetcor suitable for the transmitter in question. With the transmitter tuned, the light meter should read the approximate power output in watts.



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Alden 49
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Barry 73
Bay Roy 75
Burghardt 73
B & W 13, 73

Candee 29
Centimeg 75
Central Electronics 31
Clark 69
Clegg 35
Columbia 21
Cornell-Dubilier 9
Craftronics 4
Cubex 76
Cushcraft 77

Dale's 85
Densan 75
Dow Key 57, 74

Editors and Engineers 76
EICO 5
Elliott Electronics 74
Elmac 54
Evans Radio 49

Gam 23
Gem Electronics 54
Glasline 85
J. J. Glass 77
Graham 77, 78

Ham Aids 19
Ham TV Book 78
House of Antennas 51

International Crystal 39
Irving Electronics 57

Jefftronics 81

KTV 81

Lafayette Radio 3
L-W Electronics 59

Maps, 3D, for Xmas 55
Metro Electronics 19
Miller 67
Mini-Products 57
Multi-Products 54

National Radio .... Cover IV
Newtronics .... Cover II
Novelties 29

Palmer 85
Petersen .... Cover III
P & H 67
Polytronics 37

Radio Bookshop 60
Reyco 77
R-W Electronics 79

Skylane 79
Space Raider 7
Springfield Enterprises 86
Stellar 85
Subscriptions 56

TAB 87
Tapedcode 81
Tapetone 65
Technical Material Corp. 25
Telrex 69
Texas Crystals 63
Tri-Tronics 51
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- Kit Glyptal & Cement
- Kit 3 Phone/Patch Xfmrs
- Kit 6 Insltd Tuning Tools
- Kit 4 "Suncells" Asstd.
- Kit 5 Sub-Min Tubes
- Kit 75 Mica Condensers
- Kit 8 Crystal Diodes
- Kit 200ft Hook Up Wire
- 4 Rolls, 50ft/ea. Asstd. Color
- Kit 100 Ceramic Condensers
- Kit 5 FT243 Xtal Holders
- Kit 4 Microswitches
- Kit 8 Xtal Osc-Blanks
- Kit 4 Asstd Rectifiers
- Kit 100 Self/Tap Screws
- Kit Adj Wire Striper & Cut
- Kit Hi Gain Xtal Mike
- Kit 6 ea Phoneplugs & Jacks
- Kit 2 pair SO239 & PL59
- Kit 12 Binding Posts Asstd

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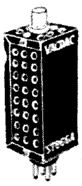
20	12.85	24.60	*Write For*	
24	15.00	29.45	*Rectifier Catalog*	

One Year Gtd!

TAB FOR XMAS
—— SPECIALS ——



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TYPE	VRMS/PIV	AMPS	PRICE
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T5R4	1900/2800	0.5	$7

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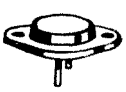
"SILTAB" Silicon Rectifier
Direct Replacement
Non-Aging Hermetically Sealed
FOB 6 or 12VDC @ 100A, Type YJ9 $24

GTDI POWER-DIAMOND-TRANSISTORS



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12VDC to 500VDC up to 200MA
100 Watts; Tap at 250VDC
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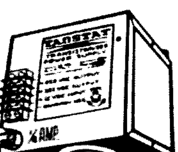

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"TAB" Tubes Factory Tested, Inspctd, Six Months Guaranteed! No Rejects! Boxed!
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6BZ6 .91	RK39 2.99	No See—Write!

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73

December 1961
37¢

Watch for Mystery Antenna Contest

73 Magazine

1379 East 15th Street—Brooklyn 30, New York

Wayne Green W2NSD—Editor, etcetera

December 1961 • Vol. I, No. 15

CONTENTS

Write Your Congressman	Dick Carruthers K7HDB	6
Ten Meter Midget Rig	Jim Kyle K5JKX/6	8
Versatilizing Meters	Joseph Leeb W2WYM	12
Regenative Detectors	Howard Burgess W5WGF	16
Another Two Meter Conversion	Roy Pafenberg W4WKM	22
Economical Custom Construction	Roy Pafenberg W4WKM	33
Avoid Precise Inaccuracy	Jim Kyle K5JKX/6	37
Wayout Measurements	Carl Henry	41
On Soldering	David Heller K3HNP	43
Two Meter Transceiver	Larry Levy WA2INM	45
Capacitor Substitution Box	John Ellison W6AOI	50
Antenna	Jim Kyle K5JKX/6	52
73 Test the Knight R-55 Receiver	Don Smith W3UZN	58
RTTY in The United Kingdom	Arthur Gee G2UK	62
Propagation Charts	Dave Brown K2IGY	64
73 Reviews the QX-535 Receiver	Al Brogdon K3KMO	66

Cover: Pen and Ink drawing by Bob Kelly K2VLO.

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Misc. & Short Items:

de W2NSD	2	New Products	32, 56
Pilot Light	14	Letters	63, 68, 76
Lamp Loads	20	Club Subs	55
		Old Xsistrs	59

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. . . de W2NSD

never say die

Would you like to know why the reciprocal licensing bill now up for Senate consideration will never see the light of day? Not enough interest, that's why. In spite of editorial treatment in all three magazines, little action was stirred up and few letters have been received by the legislators. In addition to this general apathy on the part of the amateurs there is noticeable resistance to the bill from the Justice Department.

Why should we get involved in this? Basically it is a question of being fair. We expect to be able to be licensed in other countries when we travel, and foreign amateurs feel the same way when they visit us. It is important to our international reputation that we be fair about this. The proposed law takes care of any possible security problems quite satisfactorily, though it is obvious upon reflection that this is an emotional problem much more than a real one. It is my opinion, based upon countless discussions with amateurs high in our own government, amateurs visited in many foreign countries, and lengthy talks with delegates to the last Geneva conference that amateurs will have a better chance of coming out of the next conference with usable bands if the U. S. modifies the Communications Act of 1934 to permit reciprocal licensing of foreign amateurs visiting us where there is no possible security consideration.

All of us are anxious to keep our bands intact against the pressures from other services. We are also anxious that the cloud of misinformation and confusion which bewilders most of the world about our motives be dispelled and that our image of a war-like country be brought into better perspective. Ham radio certainly won't cure anything, but it sure can help.

What to do? I don't see any solution. What is needed is someone with the time to personally visit each and every Congressman, Judicial Department official, State Department official, etc., that is in any way involved in this. We need a lobbyist and we don't have one. Those of you who saw the movie "Ikiru" know what I mean. If you didn't see it, by the way, you missed one of the finest motion pictures ever made.

Letters to Congressmen will help, but they won't do the complete job. If only I didn't have to stick with 73 every minute of every day! Even keeping at it every minute I'm behind on many things, as those of you with manuscripts submitted will testify. Isn't there someone who can spend about a month in Washington this January when Congress reconvenes and make it his business to personally see everyone involved? I'll be happy to fill anyone in on the complete background of reciprocation so they will have answers to all questions that can be raised. If I leave my desk for more than a day or two a month then there won't be a next issue. Any volunteers?

Clubs should seriously encourage their members to write per my editorial in the October 73. This does not mean that the club secretary should write a letter for all the members to sign, which is a waste of everyone's time. We will have to come up with thousands of letters. I might even put it so bluntly as to say that any amateur who does not write is effectively casting his vote *against* our hobby.

Mohawk Airlines

Niagara Falls is a little far away for us to drive, so Virginia and I flew up for the ARRL Convention a few weeks ago. Excess baggage prices being what they are, I shipped copies of the magazine, promotion literature, subscription blanks, etc., ahead two days early by Mohawk Airlines. Having had trouble with packages being held at the airport for me in the past I particularly specified that this shipment was to be delivered to the Niagara Hotel. I was assured that everything would be there for me in plenty of time. You probably can write the rest of the story for me.

We arrived at noon on Friday . . . no packages. Hmmm. I called Mohawk to see what had happened. They were out at the Buffalo airport waiting for me to pick them up. I pointed out that each individual label carefully explained that they were to be delivered and not held at the airport and that they should find this message repeated on the bill of lading. They said OK, they'd get them right over. By three I was figidy and called again. A new man was on duty and the packages were still there. Too bad, the last truck has gone for the day, maybe on Monday. I indulged in some emotion at this point and the chap suggested that I call a private company that made pickups at their office. It was difficult to locate

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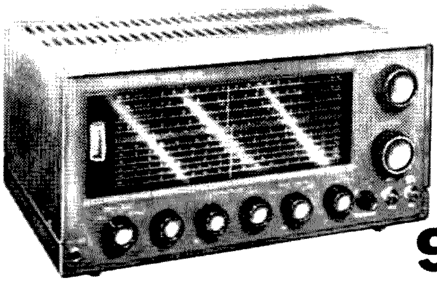

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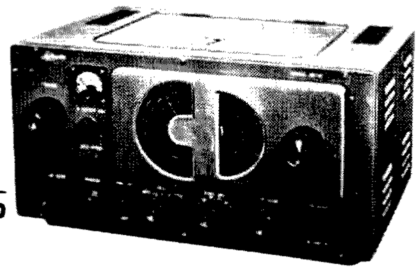

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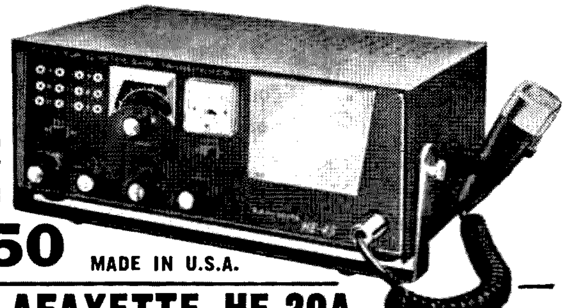

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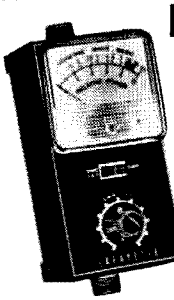

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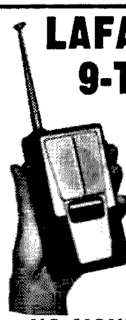

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the company from the obscure clues I had been given, but I was driven by desperation. The Convention opened at 6 P.M. and I wanted to be able to use my $100 booth.

By 5:30 I was getting nervous. The private company was closed for the night and their phone just rang and rang. Mohawk said the boxes were still there. If they weren't picked up that night then they would positively be sent out by limousine and I would have them by 8 A.M. I checked in again later at nine and midnight, but got the same story each time.

When nothing had arrived by 9 A.M. I got on the long distance phone again and found that the boxes were still at the Mohawk office. The private company had come for them at 12:30, but Mohawk wouldn't let them pick them up since there was a question as to whether the shipment was prepaid or collect. In a slightly hysterical voice I explained that the shipment was prepaid when it left me. They checked the bill of lading and weren't sure so they called New York and checked there. Along about two o'clock they had things straightened out and again promised delivery. Wonder of wonders, in came the boxes just 30 minutes before the Convention closed on Saturday. Bright side: Virginia and I had ample opportunity to see everything there is to see at Niagara Falls and vicinity. We had a fine (and expensive) vacation.

It sure is nice to have some way to blow off steam like this. It doesn't do any good, of course, but it does feel good. Actually, I need a lot larger magazine than 73 to keep up with my gripes. Being wishy-washy, as I am, things are always happening to me. Someday I'll sound off on hotels . . . my convention and wanderlust travels have put me in some three hundred hotels so far and I have a few observations. The one I remember with the most distaste is the St. Nicholas in Springfield, Illinois where my little Sony two band transistor radio was removed along with the towels. This is the only thing I've ever had stolen in a hotel. When I complained the management explained that I should have put the radio in the hotel safe if I didn't want to lose it. Grrrrrr.

Buyer's Guide

Much as I hate to back down on something, I've decided to put off the Buyer's Guide until I have more time to devote to it. That's the trouble with these one-man deals, there's only one man. Material has been coming in for the book quite satisfactorily, and quite a bit of advertising accompanied it. The problem was that I didn't have the time to send out a couple more letters to all prospective advertisers, followed up by phone calls to larger advertisers, explaining that the major purpose of the publication was for them to list their entire line of parts or equipment. As the ads

(Turn to page 70)

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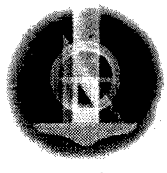

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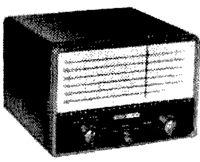

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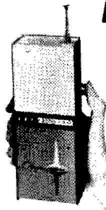

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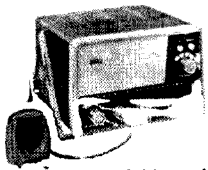

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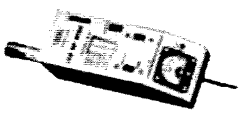

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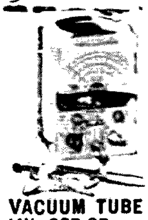

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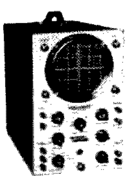

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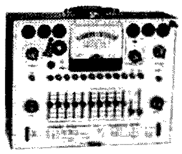

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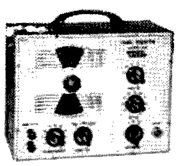

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—Making a pest out of yourself in a big way.

Dick Carruthers K7HDB
Warrenton, Oregon

If you aren't already deluging your elected representatives with passionate pleas for reciprocity in the granting of amateur operating privileges, you should be. You and I may never travel to DX-land, but if by some welcome chance it became possible, it would be nice to know we could take along the portable and operate as DX with no more difficulty than notifying the FCC and the licensing bureaus of the countries we planned to visit. It could work this way, but it is up to you to put the pressure on the lawmakers. Your elected representatives are very sensitive to your desires and if you can convince them that 'reciprocity' would be a Good Thing they will ably carry the ball.

Reciprocity in the granting of any radio operating privileges is forbidden by the Communications Act of 1934 which limits the granting of operating licenses to citizens of the United States. The one exception is a treaty with Canada concerning Public Service and Emergency radio services in which amateurs share only incidentally. The attitude of the FCC is governed by this law, and unless asked to comment by a law making body, they can only point out that according to the law, reciprocity is illegal. Any inquiry to the FCC will receive Form Letter 7400 pointing out that amateur radio operating privileges can only be granted to citizens of the United States. Unless you are persistent, this will probably be the end of it.

Your Congressman, unless he is blessed with insight and intelligence as well as vote getting ability, will probably turn your letter over to an Administrative Assistant who will forward it to the FCC, who will in turn send Form Letter 7400 to the Congressman, who will attach an autographed letter, stuff same into an envelope on which you have paid the postage, and rest in the hopeful assurance of your grateful vote come November. To avoid this runaround, make it clear in your letter that what you are suggesting is at present, Illegal, and that you feel a change in the law is called for—that this requires the passage of Senate Bill S. 2361—that it would be good for the country and especially good for the legislator who endorsed it—that the reciprocal granting of amateur operating privileges is consistent with the administrations liberal attitude toward tourists.

Above all, don't be discouraged by seeming inattention from official Washington. This is their method of natural selection. Only the strong survive—and persistence will work to your advantage.

Now, with this in front of you, here are some people who merit your attention.

Your Senator

The Honorable ....,
United States Senate,
Washington, D. C.

Dear Senator ....:

Your Representative

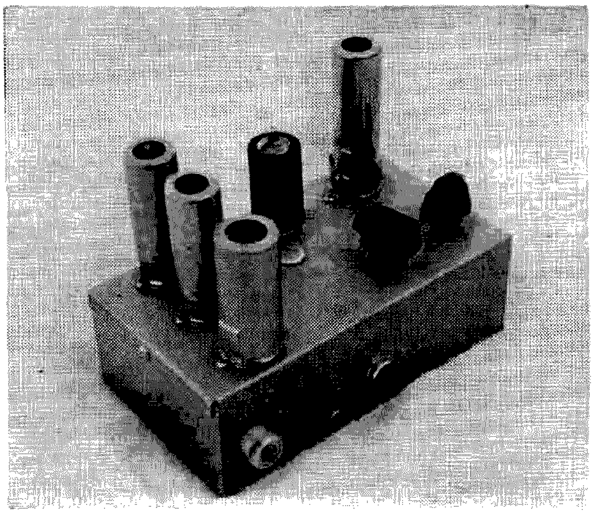
The Honorable ....,
House of Representatives,
Washington, D. C.

Dear Congressman:

Members of the Committee on Foreign Relations

John Sparkman	J. W. Fullbright, *Chairman*
Hubert Humphrey	Alexander Wiley
Mike Mansfield	Bourke B. Hickenlooper
Wayne Morse	George D. Aiken
Russell B. Long	Homer E. Capehart
Albert Gore	Frank Carlson
Frank J. Laushe	John J. Williams
Frank Church	
Stuart Symington	

If at first you fail to get the attention 'reciprocity' merits, buck and kick a little, and above all be persistent.



10 Meter Midget Rig

Jim Kyle K5JKX/6
1851 Stanford Ave.
Santa Susana, Calif.

In this day of 12-volt auto receivers, transistor power, kilowatt amplifiers built into the mobile whip, and other exotic goodies, a simple little low-power 10-meter mobile rig designed for 6-volt autos and which swipes its B+ from the car's BC receiver sounds almost obsolete.

However, a goodly number of 6-volt-plus-vibrator horseless chariots still abound on our nation's highways, and for the benefit of their owners (and anyone else who's interested in a big-sounding little rig) we present this 10-meter midget, designed and built by K6JIM.

The special feature of K6JIM's little rig is in the audio section, and is adaptable to any mobile operation. It produces screen-modulated, controlled-carrier AM—but with a difference. While rf power output is only 10 watts, the talk-power achieved in operation is equivalent to that of many 30-watt rigs due to the tricks employed.

The rf section, consisting of a 6C4 overtone oscillator and a 5763 final, appears completely conventional with the exception that it includes no parasitic chokes. This was not accidental. The hole plugs visible in the photos bear mute testimony to the hours Ron spent achieving a parts layout which would do away with parasitics; we recommend that the same layout be followed unless you like chasing whistles. However, the operating band can readily be changed to anything from 75 to 6 meters simply by changing X1, L1, and L2.

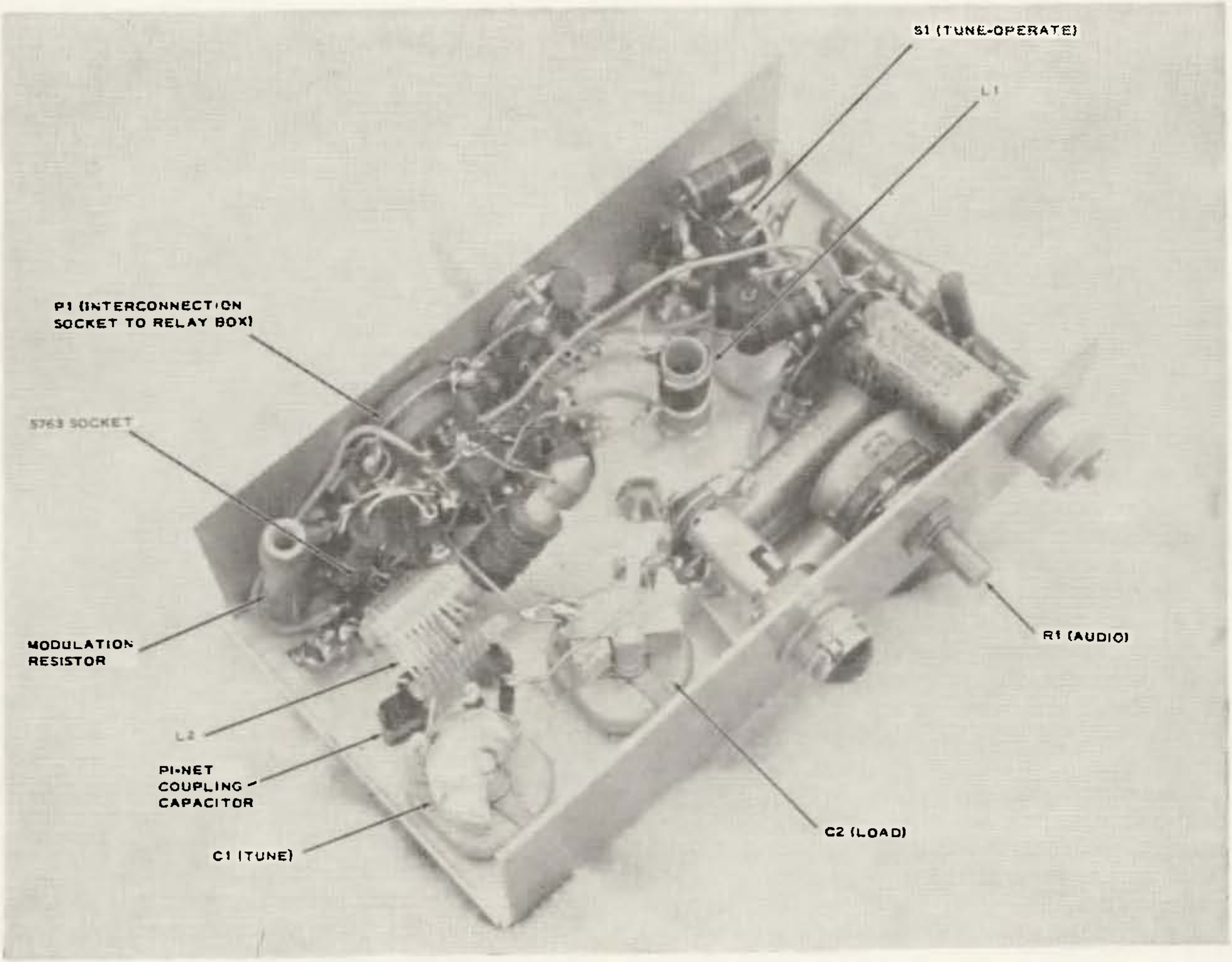
The most obvious unusual feature of the audio section is the extreme amount of decoupling used in the plate circuits of the 12AU7. This eliminates all traces of rf in the power line, thus avoiding rf feedback into the audio—one of the most annoying problems of 10-meter mobile operation.

The decoupling would also improve bass response, except that the audio coupling capacitors are chosen to cut it back for best speech characteristics. Their values should not be increased. The circuit, incidentally, is designed for operation with a ceramic mike; a dynamic will short out first-stage bias while a crystal will melt under mobile heat.

The next unusual feature resides at pins 5 and 6 of the 6AV6. This bottle was originally designed as a combination detector-AVC-first audio tube for ac-dc sets, and includes two diodes. When used in ham rigs, the diodes are usually grounded. However, Ron uses the two diodes as a peak limiter to improve the average modulation level, thus overcoming one of the more major objections to screen-modulation systems.

The diodes are biased by the 2000-ohm cathode resistor, so that they do not conduct for low-level signals. However, when a peak comes along the diodes short its positive side to ground. Nothing happens to negative peaks at this stage; they are taken care of in the final. This limiter allows considerable extra gain to be used without splattering.

The final feature of the audio section is tune-operate switch S1. When closed (TUNE position) it allows full output power from the 5763 by removing all cathode bias from the 6AQ5 modulator tube. The final is then tuned and loaded. Next, S1 is switched to the OPERATE position, and you're all set.


S1 (TUNE-OPERATE)
L1
P1 (INTERCONNECTION SOCKET TO RELAY BOX)
5763 SOCKET
MODULATION RESISTOR
R1 (AUDIO)
L2
PI-NET COUPLING CAPACITOR
C1 (TUNE)
C2 (LOAD)

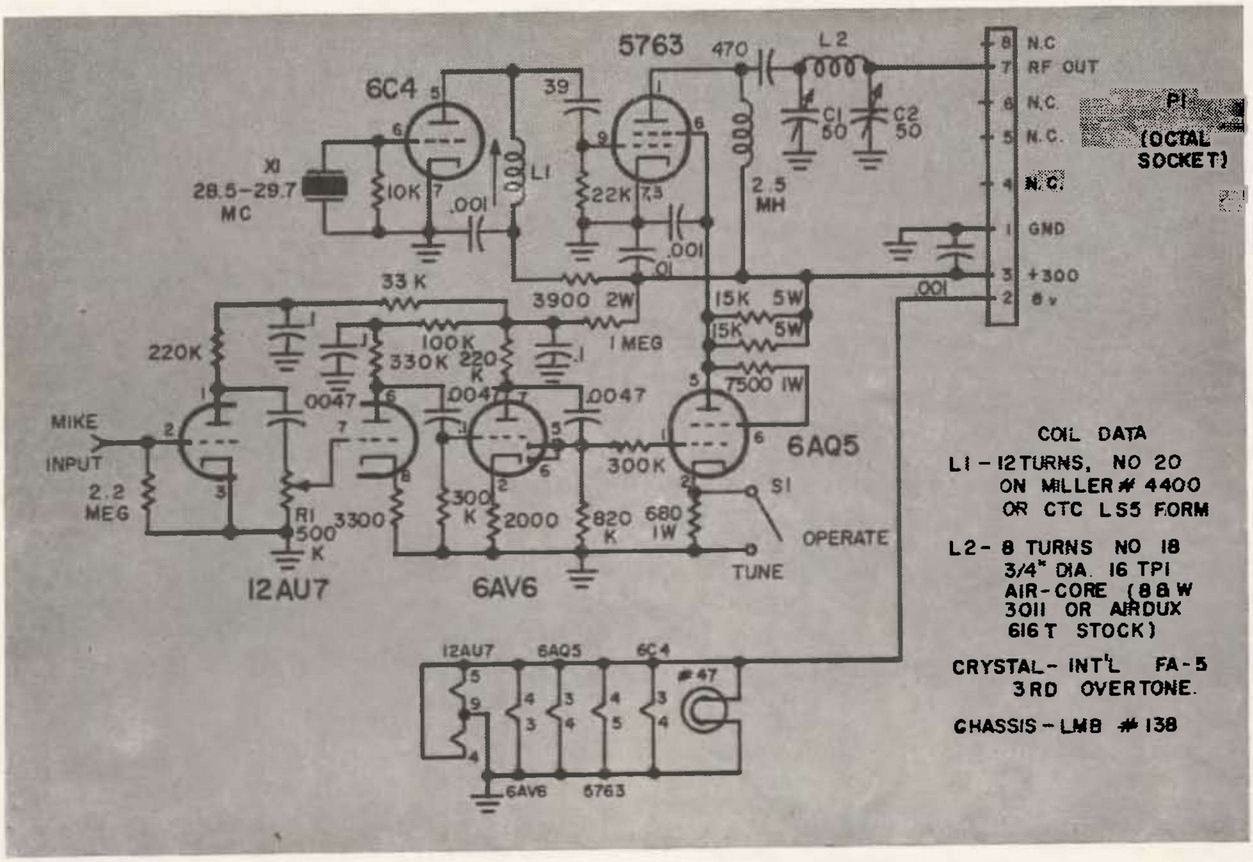
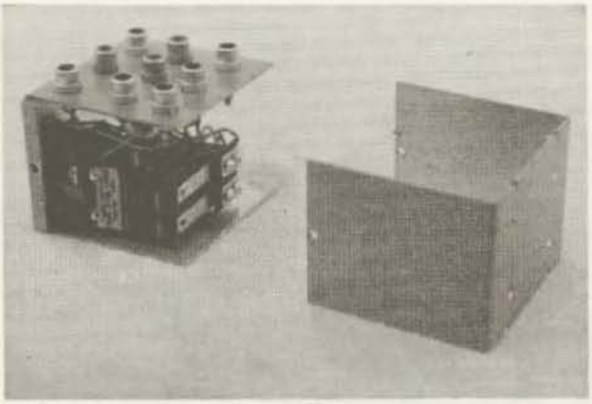

6C4
5763
12AU7
6AV6
6AQ5
X1 28.5-29.7 MC
MIKE INPUT
2.2 MEG
R1 500 K
L1
L2
C1 50
C2 50
2.5 MH
8 N.C
7 RF OUT
6 N.C.
5 N.C.
4 N.C.
1 GND
3 +300
2 6 v
P1 (OCTAL SOCKET)
S1
OPERATE
TUNE
#47
COIL DATA
L1 - 12 TURNS, NO 20 ON MILLER # 4400 OR CTC LS5 FORM
L2 - 8 TURNS NO 18 3/4" DIA. 16 TPI AIR-CORE (B & W 3011 OR AIRDUX 616 T STOCK)
CRYSTAL - INT'L FA-5 3RD OVERTONE.
CHASSIS - LMB # 138

Fig. 1



A few paragraphs earlier we said that negative peaks of audio are taken care of in the final; this action is worth a few more words at this point.

A positive audio peak at the grid of the 6AQ5 can reduce rf power output almost to zero, by increasing the 6AQ5 plate current. This increases the voltage drop through the modulation resistors, which in turn reduces screen voltage of the 5763 and cuts power output.

However, a negative peak at the 6AQ5 grid can do no more than to cut the 6AQ5's plate current off entirely. When this happens, the 5763 is on its own and produces maximum power output.

Since splatter is produced primarily by the sudden cutoff of rf output power, no negative peak at the 6AQ5 grid can possibly cause splattering.

Construction Tips

The chassis layout, photos, and schematic show most of the construction details of this rig. The original is built on an LMB No. 138 interlocking box chassis, which measures 6¼ x 3½ x 2⅛ inches. However, you are at liberty to bend your own from sheet copper or brass if you so desire.

Contacts 1 and 2 of the 6C4 socket must be removed to prevent parasitics in the oscillator, and tube shields are necessary on all tubes. The 12AU7 shield's open top should be covered with copper screen on the inside.

All components used are standard items, which should be easily available at your favorite supplier. If not, they are stocked by any of the larger mail-order houses. Note that many of the resistor values are obtainable only in 5-percent tolerance units; the 2000-ohm 6AV6 cathode resistor is one of these, and its value should not be changed. Unless otherwise indicated, all resistors are ½-watt.

If you have a 12-volt car instead of a 6-volt model, you can still use this rig by substituting 12-volt tubes and modifying the filament wiring. The 6C4 can be replaced by one section of another 12AU7 (changing the socket to 9-pin, naturally; remove contacts 1 through 3); the 6AQ5 by a 12AQ5; the 6AV6 by a 12AV6; and the 5763 by a 6417. The existing 12AU7 will need only its filament wiring changed.

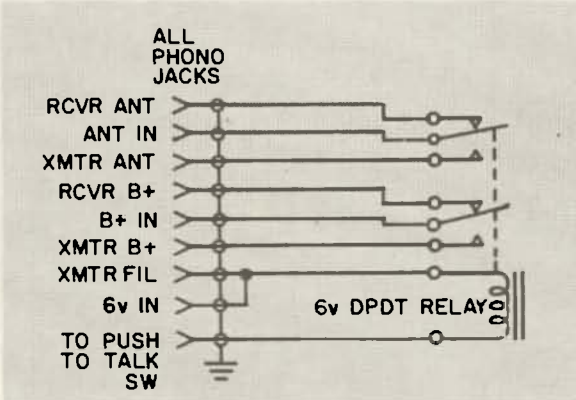


Fig. 2

Power Supply and Control Circuits

As mentioned earlier, this rig swipes its power from the car receiver. This is done through interconnection socket P1 and a relay box. The relay box is wired as shown in Fig. 2 and the photos.

In the car BC receiver, the B+ line is broken between the power-supply output and the audio output stage and replaced by a 3-contact socket, as shown in Fig. 3.

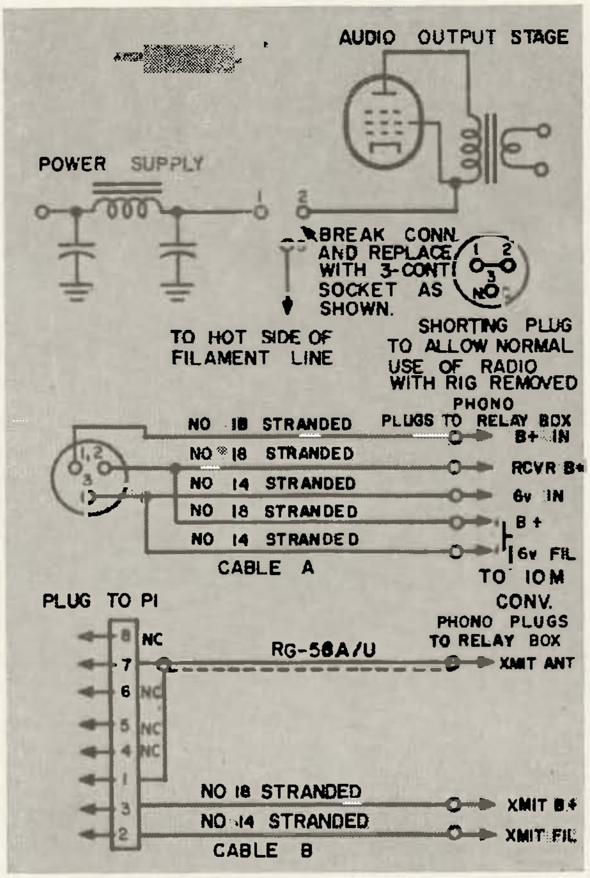


Fig. 3

For mobile operation, Cable A (Fig. 3) is plugged into the car receiver and the appropriate relay box jacks. The separate 10-meter converter is also connected to Cable A on the receiver side. Cable B is plugged into P1 and its relay box jacks. The antenna lead connects to the relay box, and a separate coax cable connects the "rcvr ant" jack of the relay box to the converter input. (This all reads considerably more complicated than it is in practice.)

With all connections made, the rig itself can be hidden under the front seat or against the firewall under the dash, since it requires no adjustment during operation. Only the mike and the push-to-talk switch need be accessible for use of the rig. Pressing the switch operates the relay, which switches B+ from receiver to transmitter and also changes over the antenna.

Tune-up Procedure

You can see that no metering or meter jacks are included in this little midget. The reason for this is that the rig is designed for fixed-frequency operation; you tune it up on initial installation, then forget it. Here's the procedure:

First, measure the voltage at the junction of L1 and the 3900-ohm resistor, using a VTVM, while tuning L1 for a peak reading. Once you have the peak, take a quick check at the 5763 grid for approximately —30 volts. Now place S1 in the TUNE position, C2 fully meshed, and use a field-strength meter to determine transmitter output while tuning C1 for maximum.

With C1 tuned for maximum power output and C2 fully meshed, reduce the capacitance of C2 slightly and retune C1 for a new maximum. This reading should be greater. Continue this adjust-and-retune sequence until the power output drops just perceptibly from the preceding reading. Touch up the tuning of L1; if power output increases, continue the adjust-and-retune sequence. The object is to apply maximum grid drive, and to load the transmitter until the power output just begins to drop from the maximum obtainable—this is the tuning requirement for all screen-modulated rigs, but S1 makes this one simpler than most.

When tune-up is complete, switch S1 to the OPERATE position—and talk.

Problems and Consultation

The designer and builder of this rig is Ron Nelson, K6JIM, owner and operator of Custom Electronics, 19315 Sherman Way, Reseda, Calif. All questions, problems, and comments should be directed to him, with S.A.S.E., please. . . . K5JKX/6

Versatilizing Meters

Joseph Leeb W2WYM
549 Green Valley Road
Paramus, New Jersey

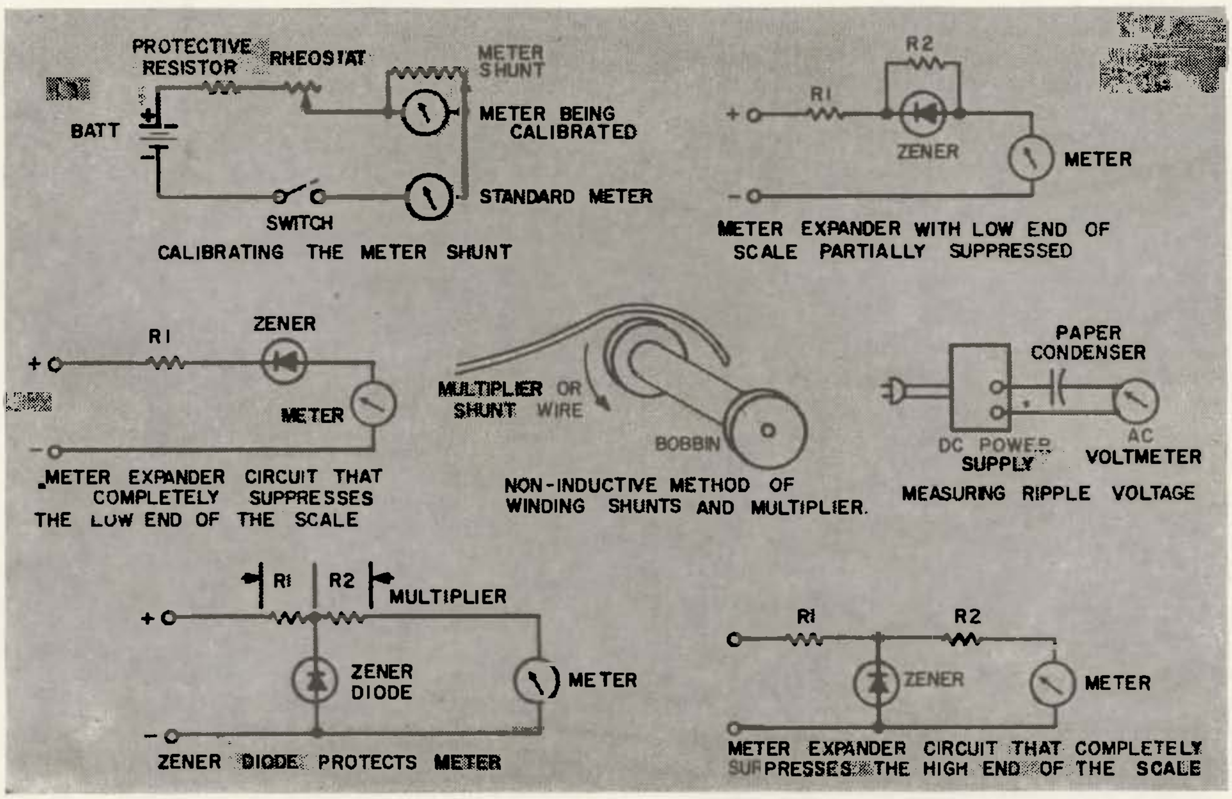
Meters, though one of the less-abundant items in the average shack, are very versatile and lend themselves nicely to conversion to various ranges and types of current.

Take, for example, the familiar 0-1 dc milliammeter. This instrument can be adapted to measure practically any range of dc current, with the proper shunt, or any dc voltage range if the correct multiplier is used. By adding a meter rectifier the instrument becomes an ac meter. RF can also be measured with the same instrument, using a diode to rectify the current to dc.

Shunts and multipliers are relatively easy to make. For the ham who is allergic to mathematics, the cut-and-try method is the least painful. Suppose we wished to increase the range of our 0-1 mil meter to measure 10 amperes. The handiest material around the shack is some copper magnet wire. The question now arises: what size wire and how much? Let's start with two feet of #16. This size can carry 10 amperes safely, and two feet allows for trimming the shunt to proper size.

Hook up the circuit as shown in Fig. 1. Start with the full resistance of the rheostat in the circuit. If the meter under test reads too high, the shunt wire is too long; unsolder one end of the shunt from the terminal, shorten the wire a little, and resolder. *Be sure the switch is open* when making any changes. The meter may show a reading for a minute or so after re-soldering the shunt wire, even though the battery is disconnected. This is due to the thermocouple junction produced by the dissimilar metals at the soldered joint. As the joint cools, the meter reading will gradually drop to zero.

Neglecting the economy angle, copper is not the best material for shunts or multipliers.



6 1 4 2 5 7 3

The resistance of copper changes with temperature, resulting in inconsistent readings on our meter. If you can lay siege to some low temperature coefficient wire (manganin, nichrome, etc.) you will have a more consistently accurate instrument.

On cold, dry days an amazing phenomenon rears its ugly little head in the shack,—meter needles deflect *before* the current starts to flow, and readings jump suddenly in a most mysterious manner. What causes this? Static! Rub the glass window of any meter with a silk cloth (the bare finger will do for people who lack affluence). The friction produces a static charge at the area of contact, and the meter needle will be attracted. Deliberate rubbing is not always necessary,—a passing breeze sometimes changes a meter reading. Fortunately, there is a cheap and dirty method of squashing this static bug. Take a damp strip of chamois leather and lay it on the meter face so as to make contact with both the window and the flange, and the static charge will be dissipated as fast as it forms. Another method is to mount a piece of coarse-mesh wire screening inside the glass. This, by the way also helps in preventing rf leaks in a transmitter, and is a point to keep in mind when TVI-proofing your rig.

Meter multipliers, as well as meter shunts, require some special treatment. Having the proper resistance, and being wound with low temperature coefficient wire is not enough. The multiplier must have no magnetic field around it when current flows through it. This little trick is accomplished by winding the multipliers non-inductively. A length of insulated wire having the desired resistance is first measured off. The wire is then strung out, doubled, and wound on a bobbin, starting with the loop in the center of the wire. (See Fig. 2).

RF has a nasty way of getting into a dc meter movement, sometimes with disastrous results. A high-grade mica bypass condenser across the meter terminals will help keep the rig on the air.

Where both ac and dc are present in a circuit (such as the output of a power supply that has insufficient filtering), the ripple voltage can be measured quite easily if we connect an ac voltmeter in series with a paper condenser across the output terminals of the power supply. The condenser passes only the ripple component to the meter, and holds back the dc (Fig. 3).

Overload protection for meter movements is obtained efficiently with zener diodes. These little watchdogs are faster and more reliable than fuses, and, best of all, they are self-healing. The zener is one of the oddballs of the diode tribe. Unlike the common diode, which conducts in one direction but is an insulator when the current reverses direction the zener does not pass any current to speak of, in either direction, until the applied voltage rises to a certain critical value, at which point the zener breaks down and conducts. When the voltage falls below the breakdown point, the zener once again becomes an insulator. Zener diodes are made for a wide range of breakdown voltages. Two or more zeners may be connected in series to provide any required voltage breakdown characteristic.

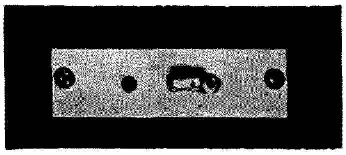
At this point it might be wise to mention that zener diodes cannot be tested like the ordinary unilateral conductor. An ohmmeter check will not indicate the true condition of a zener; it is necessary to apply rated breakdown voltage to see if conduction takes place.

Fig. 4 shows how a zener diode is connected to protect a meter against burnout. R1 and R2 are the two sections of a multiplier or voltage divider. Values of R1 and R2 are chosen so that the voltage at their common point is near the breakdown voltage of the zener diode when rated current flows in the circuit. Any voltage in excess of the safe maximum value will cause the zener to break down and conduct, relieving the strain on the meter.

Another interesting application of the zener diode is in the suppressed-zero and expanded-scale meters. Fig. 5 shows a circuit in which the low end of the scale is partially suppressed. This feature is useful where the low end of the scale is of no particular interest. The meter remains at zero until the current reaches the desired minimum value, at which point the zener diode breaks down and conducts. R1 is used for upper scale calibration, while R2 is adjusted for the required degree of low end suppression. If it is desired to completely suppress the low end of the scale, connect up according to Fig. 6.

There are cases where only the low end of the meter scale is important, and the high and is to be suppressed. In Fig. 7 this is accomplished by causing the zener to break down before the voltage exceeds a certain predetermined value. . . . W2WYM

Miniature Pilot Light



The limiting factor in compact construction is often the available "front of panel" space for adequate marking and operation of the various controls. One low cost, readily obtainable item to assist in easing this problem is available from automotive supply stores.

The miniature jewel indicator lamp shown in the photograph may be purchased, at a cost of 27¢, from Western Auto under their part number 2L6208. The socket part of the lamp is of standard size, but the 5/16" diameter, ruby jewel mounts in a ¼" hole and its use does much to reduce front panel congestion.

. . . W4WKM

Howard F. Burgess W5WGF
1801 Dorothy Street, N.E.
Albuquerque, New Mexico

The Regenerative Detector

MORE regenerative detectors have been built and cussed than any other circuit in radio. More weird noises have come from regenerative detectors than from any other "instrument of the devil." In spite of all of this they refuse to die, even though their obituary has been written by a number of authorities.

The circuits were far from ideal in their early uses but they served a purpose. Their great sensitivity reduced the number of tubes required at a time when tubes were expensive, delicate, and crude.

No one should ever plan on reviving the regenerative detector for general use but it does have some characteristics that recommend it for special applications.

The following story is not intended as a "how to build it" for these particular uses but only as a suggestion to amateurs who like to design their own projects.

For those who have never nursed a sick detector through the early hours of the morning, it might be well to list a few good features as well as the bad. The good points run something like this.

A. The regenerative detector is capable of very high gain. A gain of over 18,000 can be realized in one tube.

B. It does not require a separate BFO for CW reception.

C. It can be made highly selective.

D. It will operate with very low plate voltage and current.

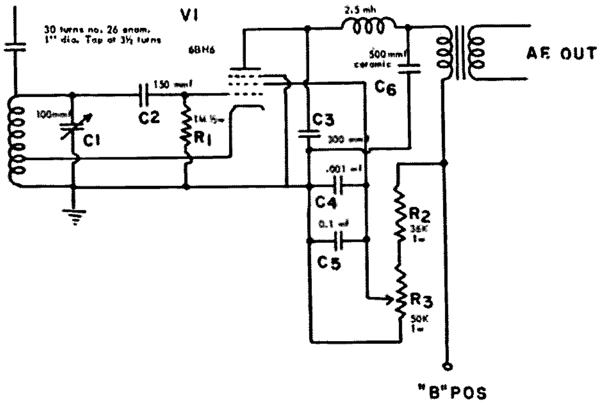


Fig. 1. The electron coupled regenerative detector circuit was used in sensitivity and selectivity tests.

On the other side of the ledger are a number of bad points that have given the circuit a poor reputation. Several of them are:

E. The regeneration control must be continually varied as the detector is tuned.

F. The selectivity curve becomes very broad on strong signals.

G. Simple AVC circuits are not practical.

H. When connected directly to an antenna, the detector suffers from instability and dead spots.

The last four items are enough to discourage all but the hardy souls. However A, B, C, and D would indicate the circuit has something to offer where space and current drain are important, such as in small portable equipment.

If the operator is willing to sacrifice AVC for space and power savings, three of the four objections can be overcome by using the circuit as the second detector of a simple superhet receiver. The regeneration control becomes quite stable because the detector is operating on a fixed frequency. The selectivity can be kept quite good by limiting the sigal that reach the detector, and antenna coupling is no longer a problem.

The items A, B, C, and D will all contribute to a compact, high gain *if* system *that* requires very little power to operate.

The simple superhet using a regenerative detector is not new. It has been in use for years, but there seems to be very little data available on what to expect from such a circuit. To get firm figures rather than speculation several circuits were wired and tested.

One of the circuits tested is shown in Figure 1. It is the well-known electron-coupled regenerative detector that has been in use for years. The sensitivity and selectivity tests were run at 4.5 megacycles. This frequency is satisfactory as an *if* for six or ten meter receivers. If the frequency of the detector is decreased for use on the lower bands, its characteristics will actually improve.

It is well known that the regen circuit has high gain and is very sensitive but the number one question was, "How sensitive?" or, "What is the weakest signal that we can receive?"

As a practical approach, a pair of high impedance headphones were connected in the plate circuit of the detector and a known sig-

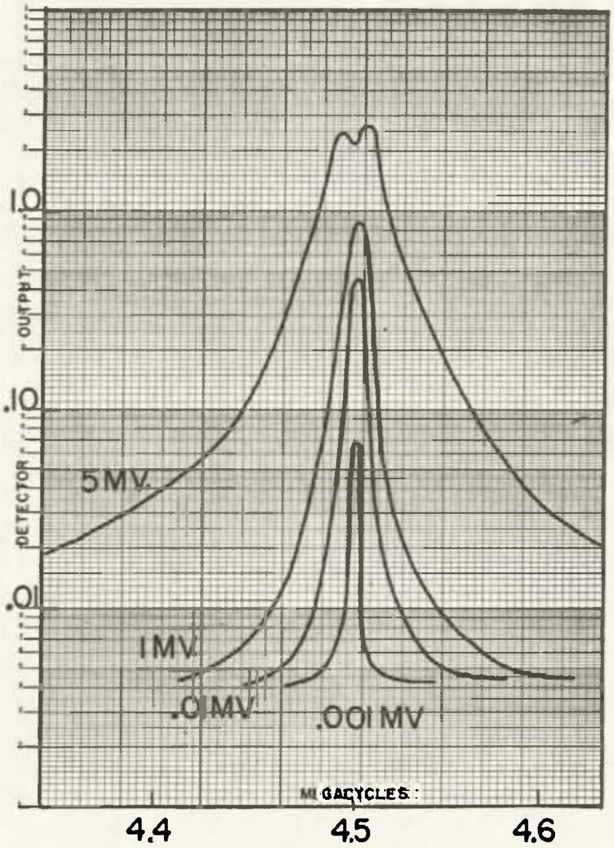


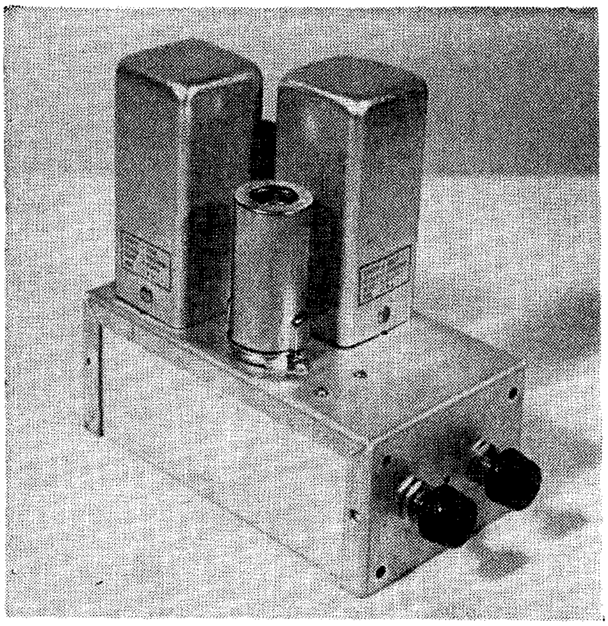
Fig. 2. The selectivity curves show the broadening effect of increasing signal strength.

nal level fed to the input. The signal was reduced to the lowest readable value and the results were surprising. A one microvolt CW signal could be copied and a modulated signal of six microvolts was quite readable. This would indicate that very little gain would be required ahead of such a second detector.

Item F says that the selectivity curve broadens out with a strong signal. To find out just how much, several curves were run. The results are shown in Figure 2. The regeneration control was set just below the critical point of oscillation and the signal was modulated with a 400 cycle tone. The most selective curve shown was obtained with an input of 10 microvolts. The next curve shows the effect of increasing the signal to 100 microvolts. The following curve is that of 500 microvolts input and is followed by the 1 millivolt and finally the broad 5 millivolt curve.

On the basis of these measurements an experimental *if* system operating at 1600 kc was constructed. The final results are shown in Figure 3. A simple amplifier was placed ahead of the regen detector, not to give additional gain but to give greater control over the signal level reaching the detector. However, because the amplifier does contribute to the gain of the system, a simple triode detector circuit can be used.

The system was designed ao operate on any available voltage from 45 to 100 volts. This allows it to be used on a B battery or the



The final circuit uses two tubes to give a sensitivity of one microvolt.

simplest of vibrator supplies to conserve power. The completed unit consists of the *if* amplifier, detector and a stage of audio amplification. The total current drain from the B supply is 7 mils at 75 volts.

The measured sensitivity shows a signal 10 db above noise with an input of 3 microvolts. A one microvolt modulated signal is audible. This *if* system, using only two tubes, has more gain than many communication receivers.

It is clear from the photos that no attempt was made to miniaturize this experimental model, but even with the large *if* cans the entire unit measures only 3" x 5" and has room to spare. With small coils and some crowding it could probably be put in half the space of the original.

For those who are interested in constructional details, the diagram and photos tell the whole simple story except for the coil added to the second *if* transformer. The cathode coil of the detector consists of four turns of No. 30 insulated wire wound tight against the secondary pie of the transformer. The coil must be correctly polarized, give the desired regenerative action. If the detector does not break into oscillation somewhere in the range of R8, the connection to the cathode coil should be reversed. If other types of *if* transformers are substituted, more turns may be required on this coil to give enough feedback.

If good phone signals are being received the regen control can be operated somewhat below the point of oscillation. For very weak phone signals the control can be pushed up to the critical point just on the verge of oscillation, and for CW the control is advanced to the region where the detector is in actual oscillation.

The *if* gain control in the amplifier stage should be kept reduced to a point where the detector is not overloaded with the signal. As this control is reduced, the regen control can be moved up and selectivity increased.

We have not given details for a complete receiver; this will be left to amateur designers. Almost any tunable convertor intended to be used with a broadcast receiver will work as a front end. More audio amplification can be added as desired.

One word of restrain should be added. A receiver designed along these lines is not intended as a replacement or substitute for the regular communications receiver. It is suggested rather as a means of filling the spot where, for either size or current drain, the

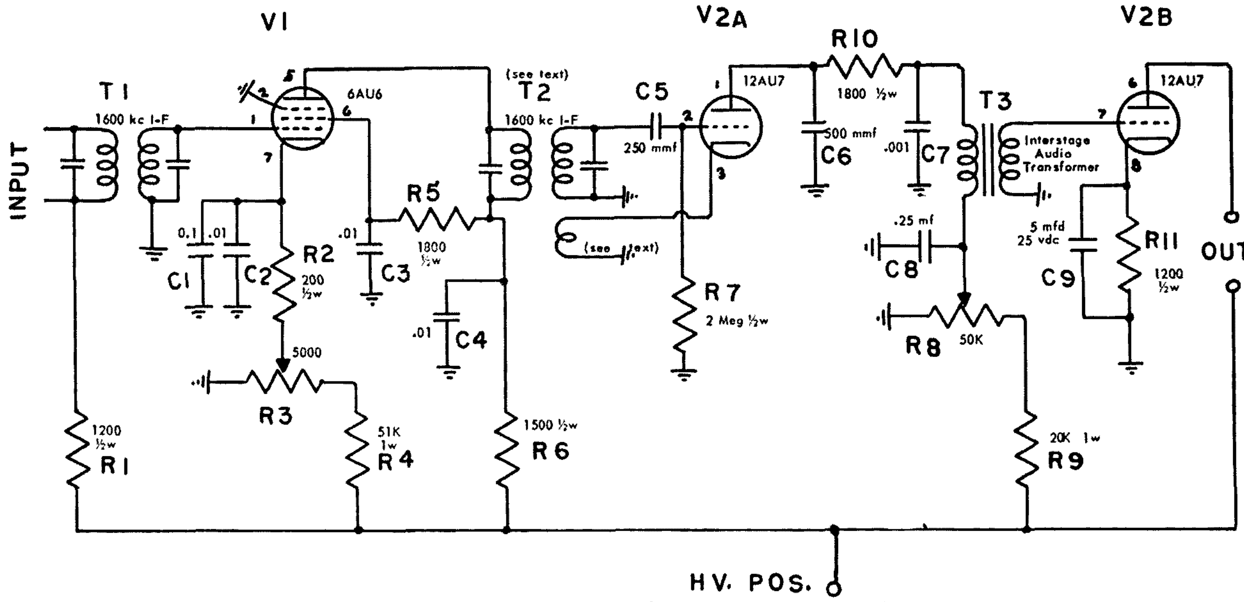


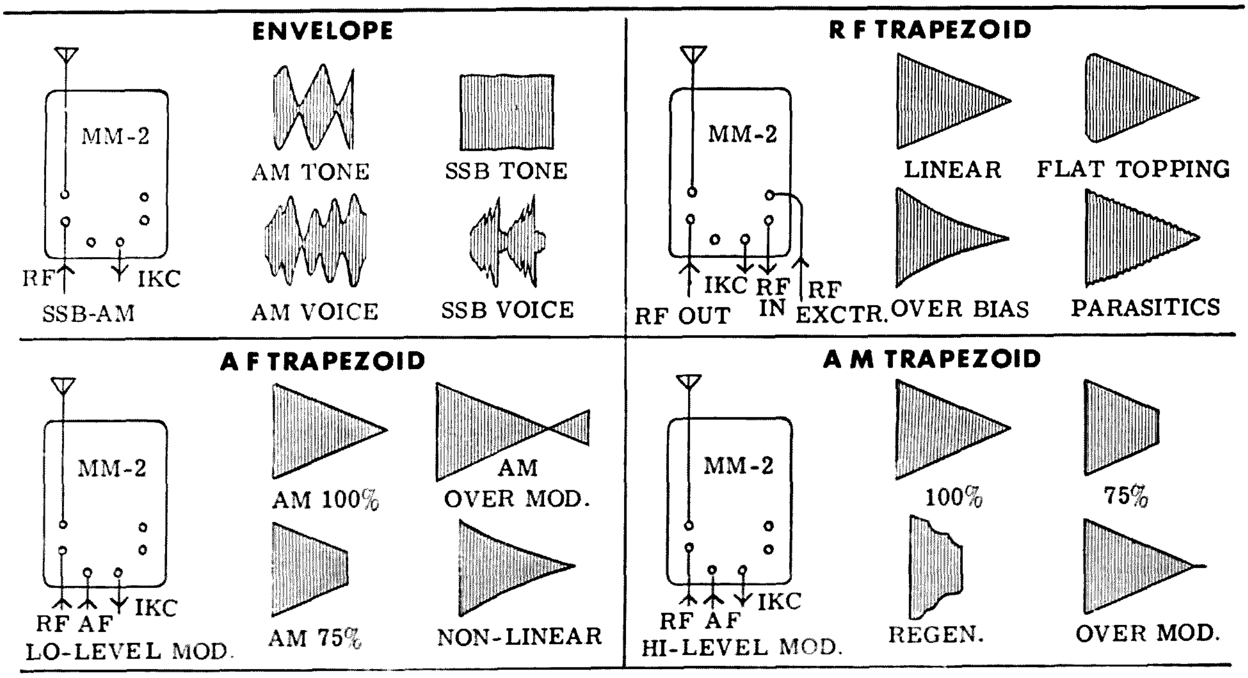
Fig. 3. The IF and audio system is a simple module that can be used with various front ends.

THE MULTIPHASE MODEL MM-2 *RF* ANALYZER

- Monitors the RECEIVED and TRANSMITTED signals. Shows flat-topping, overmodulation, parasitics, keyed wave shape etc. Silent electronic switching keyed by transmitted RF.
- No tuning required. Broadband response flat 1 MC to 55 MC at power levels of 5 watts to 5 KW.
- New variable sweep control for transmit and receive.
- RF attenuator controls height of pattern. Calibrated in 3 DB steps.
- Function selector for ENVELOPE, TRAPEZOID and BOW-TIE patterns on transmit. For SSB, DSB, AM and CW.
- Built-in 1 KC audio oscillator, less than 0.5% distortion. With 3" scope, is ideal for complete alignment of SSB exciters.
- For use in series with 52-72 ohm coax lines. A short pickup antenna may be used with other systems.
- Plug-in adaptors available to match 50 KC, 60 KC, 80 KC or 455 KC receiver IF systems. Only one simple connection to receiver.

MM-2 Kit . . . (less IF adaptor). $119.50
Wired . . . (less IF adaptor). $149.50
Plug-in IF adaptors (wired only) . . . . . .
RM-50 (50 KC). RM-80 (60-80 KC).
RM-455 (450-500 KC). . . ea. . . $12.50

THERE IS NO SUBSTITUTE FOR A SCOPE IF YOU WANT THE CLEANEST, MOST PERFECTLY MODULATED SIGNAL YOUR TRANSMITTER CAN PROVIDE. THE MM-2 IS BY FAR THE MOST DEPENDABLE and EASIEST TO USE, SINCE IT WAS DESIGNED STRICTLY FOR THIS PURPOSE.



WRITE FOR LITERATURE

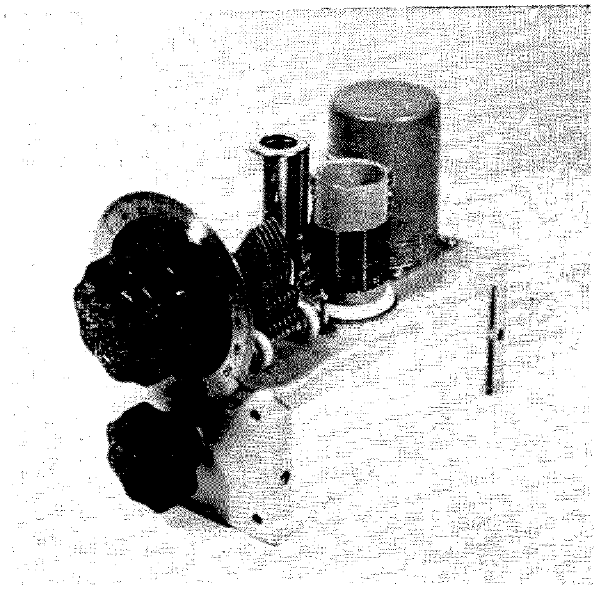
THE SSB PIONEER

MULTIPHASE EQUIPMENT

Central Electronics, Inc.

1247 W. Belmont Ave. Chicago 13, Illinois

A subsidiary of Zenith Radio Corp.



The one tube module used in the original test will be used in future combinations.

regular receiver cannot be used.

Of course, you don't have to tell an old-timer that a simple one-tube regen can be an excellent "last ditch" receiver just as it stands—"barefooted."

. . . W5WGF

Lamp Loads

The general unsuitability of the incandescent lamp as a dummy load for radio transmitters has been discussed in references too numerous to cite. Among the problems are the wide excursions of impedance at various power levels and the high level of radiated signal. As a point of fact, the variation of load impedance with transmitter modulation can often produce misleading results.

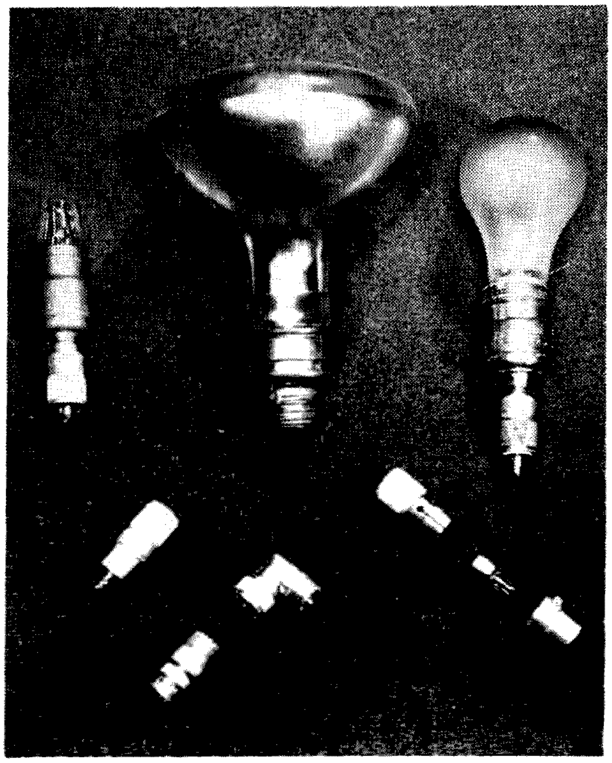
Be this as it may, the easy availability and economy of these dummy loads results in their general amateur use. Termination of the lamps in standard coaxial fittings and lamp sockets will serve to reduce radiation and, if an impedance match is possible, serve to reduce the SWR. The photograph shows a number of adaptors that simplify the connection of the

lamp load. In each instance, the coaxial connector is a version of the PL-259 UHF plug. *Brass* lamp sockets, without switch, are used for the standard and intermediate screw base lamps. The PL-259A plug is used in these loads.

Connection between the lamp socket and the coaxial plug is made by means of a modified UG-176/U reducing adaptor. The larger diameter bushing on the end of the fitting is sawed off and this end is threaded into the coaxial plug. The unthreaded ferrule is slipped into the threaded bushing of the lamp socket shell and secured by the set screw. The unit is wired by soldering a short lead to the inside of the socket shell and connecting this lead to the sleeve of the socket. The center connection is wired straight through with a length of insulated wire.

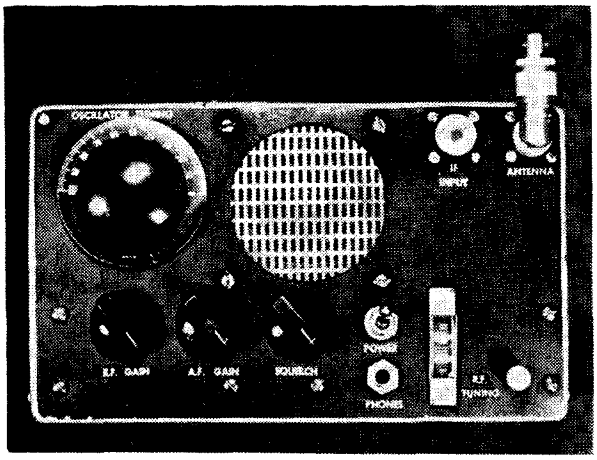
The miniature bayonet base lamp load is fabricated from a PL-259 (do not use the PL-259A) plug. The retaining pins on the lamp are snipped off and a bare lead soldered to the center contact. The split ferrule of the PL-259 is spread slightly and the lamp inserted. The center contact of the plug is then soldered and the job is finished.

Photo Credit: Morgan S. Gasman, Jr.



These dummy loads are very convenient to use. Their versatility can be extended through the use of standard connector-adaptors, two of which are shown in the photograph. If you must use lamps for dummy loads, the method shown is as good as any and better than most.

. . . W4WKM



End-on view of the converted receiver. New finish plate is fitted over old front panel and decals applied to show location of new controls.

Conversion of the R-77/ARC-3 Receiver Provides Continuous Coverage From **100** *to* **156** *mc Without Undue Sacrifice of* **2** *Meter Bandspread.*

Roy E. Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Photography by: Morgan S. Gassman, Jr.

Another 2 Meter Conversion

THE major components of the AN/ARC-3 Radio Set have reached the suplus market in quantity and are priced so attractively they are difficult to pass up. The AN/ARC-3 is an airborne receiving and transmitting equipment designed to provide plane-to-plane and plane-to-ground VHF communication. Remote control facilities are provided in both the transmitter and receiver to permit automatic tuning to any one of 8 crystal controlled frequencies in the range of 100 to 156 mc. The equipment consists of the R-77/ARC-3 receiver, the T-67/ARC-3 transmitter and the DY-21/ARC-3 dynamotor; all designed to operate from the usual 28 volt dc aircraft supply.

The R-77/ARC-3 receiver holds promise as a 2 meter, home station receiver and this article describes such a conversion. This unit is a 17 tube, crystal controlled, superheterodyne receiver. The 8 operating channels are selected by an electrically operated, motor driven tuning system that is entirely automatic.

The variable capacitors are driven by a motor which is controlled by the output of the harmonic generator so that the tuning drive mechanism is automatically stopped when the tuned circuits resonate at the desired harmonic of the crystal oscillator. "Lock out" of undesired harmonics on each channel is accomplished by "pre-set" switches mounted on the front panel. These switches, which are calibrated in mc, "unlock" the control system in those segments of the spectrum in which the desired harmonics occur.

The circuit employs an rf stage with a preselector and a five stage crystal controlled harmonic generator, which produces a signal 12 mc lower than the incoming rf signal. This voltage is used to operate the tuning system and is also mixed with the incoming *rf* signal to produce the *if* frequency of 12 mc. Three stages of *if* amplification are provided, followed by a diode second detector. Delayed AVC, noise limiter and squelch circuits are employed and are followed by a three stage audio amplifier. The audio system uses heavy inverse feedback and provides a maximum output of 1.3 watts into a 600 or 30 ohm load.

In this conversion the motor drive is removed, the exterior is demilitarized, a new front panel with the required controls is added and an ac power supply and speaker are installed. Other changes include conversion of the crystal oscillator to a continuous tuning HFO, rf gain, audio gain and squelch controls. As the photographs show, the result is a commercial appearing receiver that, while not "state of the art," will produce acceptable results for local VHF work.

Initial work clears the deck for action. Remove the unit from the shock base and scribe marks on the oversize bottom plate, using the sides of the case as a guide. Remove the bottom plate and have the plate sheared to these marks. The local gutter shop will probably do the job gratis. Remove the top and the wraparound sides and back. Drill out the rivets securing the 4 stabilizer brackets to the sides of this cover and discard the brackets. Retain the bottom plate, wrap-around cover and top, along with the mounting hardware. Remove and discard, along with mounting hardware, the crystal compartment door, the relay adjustment cover plate and the nomenclature

Christmas Suggestion

For giving or getting . . . what more exciting gift can you imagine than one of these great ham stations by Clegg! But don't take our word for it. Any owner of a Clegg Zeus or 99'er will tell you. Ask him about the wonders he's working with DX — the plaudits he's receiving from fellow hams about his signal — and the incomparable design, construction and operating features so unique with his Clegg unit!

CLEGG ZEUS VHF TRANSMITTER for 6 and 2 Meters

- ★ **Highly efficient 185 watt AM, high power VHF transmitter for full coverage of amateur 6 and 2 meter bands and associated Mars frequencies.**
- ★ **Automatic modulation control with up to 18 db of speech clipping. Gives you "talk power" greater than many kilowatt rigs!**
- ★ **Self-contained stable VFO. Simple band switching and tune-up.**

Amateur net price: $675. Completely wired and tested with all tubes, Modulator, Power Supply, VFO, cables, etc.

99'er 6 Meter TRANSCEIVER

- ★ **A true ham station, ideal for both fixed station and mobile operation.**
- ★ **Double conversion superhet gives you extreme selectivity and freedom from images and cross modulation.**
- ★ **Transmitter section has an ultra-stable crystal oscillator which also may be controlled by external VFO.**
- ★ **Efficient, fully modulated 8 watt final works into flexible Pi network tank circuit. Large S meter serves for transmitter tune-up procedure.**

Amateur net price: $139.95.

We're sure you've heard glowing reports like these typical unsolicited comments that we are constantly receiving:

About the Zeus

". . . I have been in amateur radio since 1912 and have been active ever since and will say that this transmitter is the finest that meets my opinion of what a transmitter should be . . ."

George R. Mathias, W9ZHR, Illinois

". . . more than exceeds my expectations. I am in QSO with stations I never knew existed before . . ."

Leo Winter, Jr., D.D.S., WA2TIA, New York

"Have been using this rig for less than a month and all ready have worked twenty or more states on six meters. It is equally good on two meters. Get wonderful reports up and down the coast of California . . ."

Jay Mahoney, W6YDF, California

". . . I am doing very FB with the Clegg, getting more than my share of DX . . . I have had some remarkable QSO's on your Clegg . . ."

William T. Shaw, W6BWK, California

ABOUT THE 99'er

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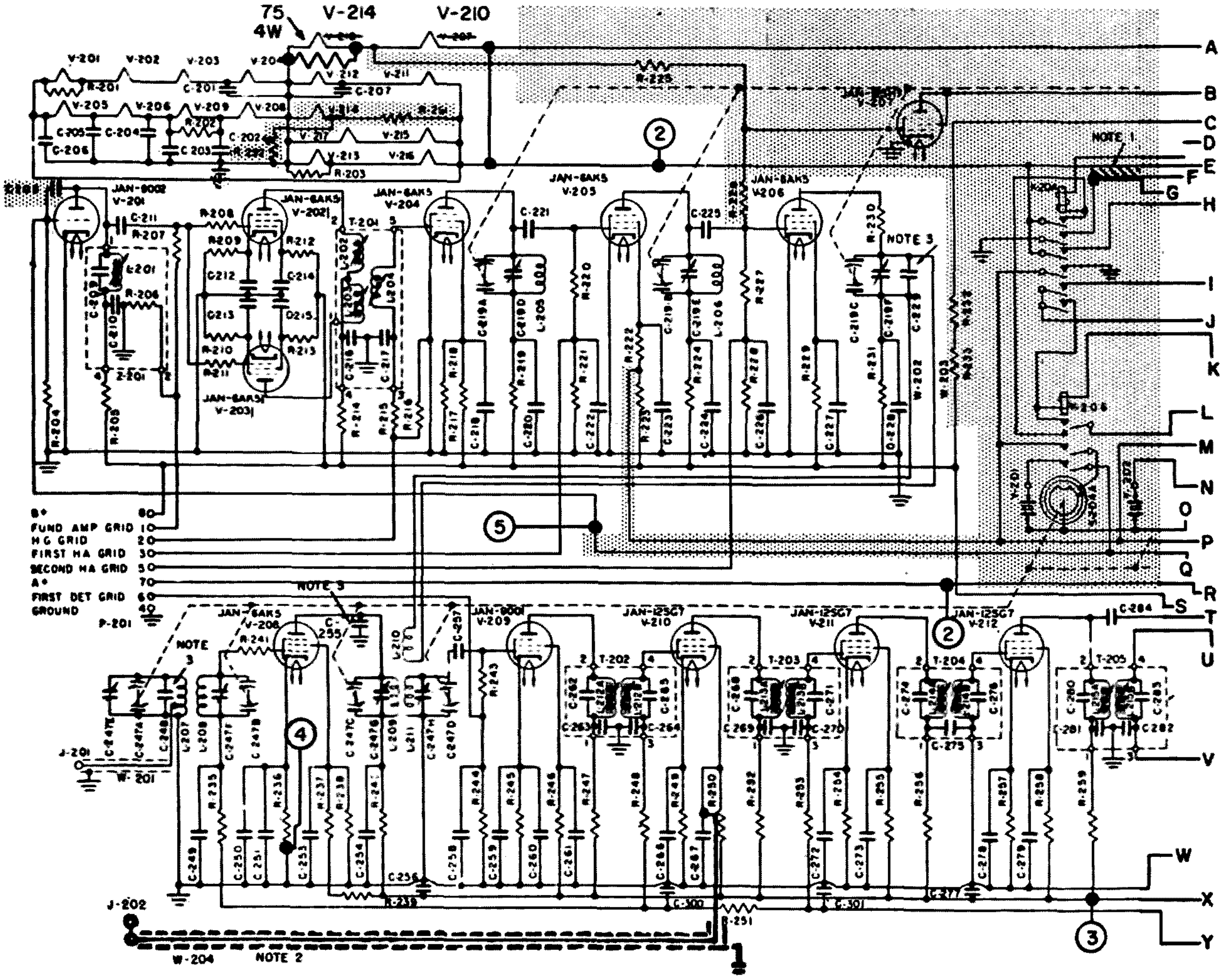
75 4W
V-214
V-210
NOTE 1
NOTE 3
NOTE 2
JAN-6AK5
JAN-9002
JAN-12SG7
JAN-9001
B+ 8
FUND AMP GRID 1
HG GRID 2
FIRST HA GRID 3
SECOND HA GRID 5
A+ 7
FIRST DET GRID 6
GROUND 4
P-201
J-201
J-202
W-204
A
B
C
D
E
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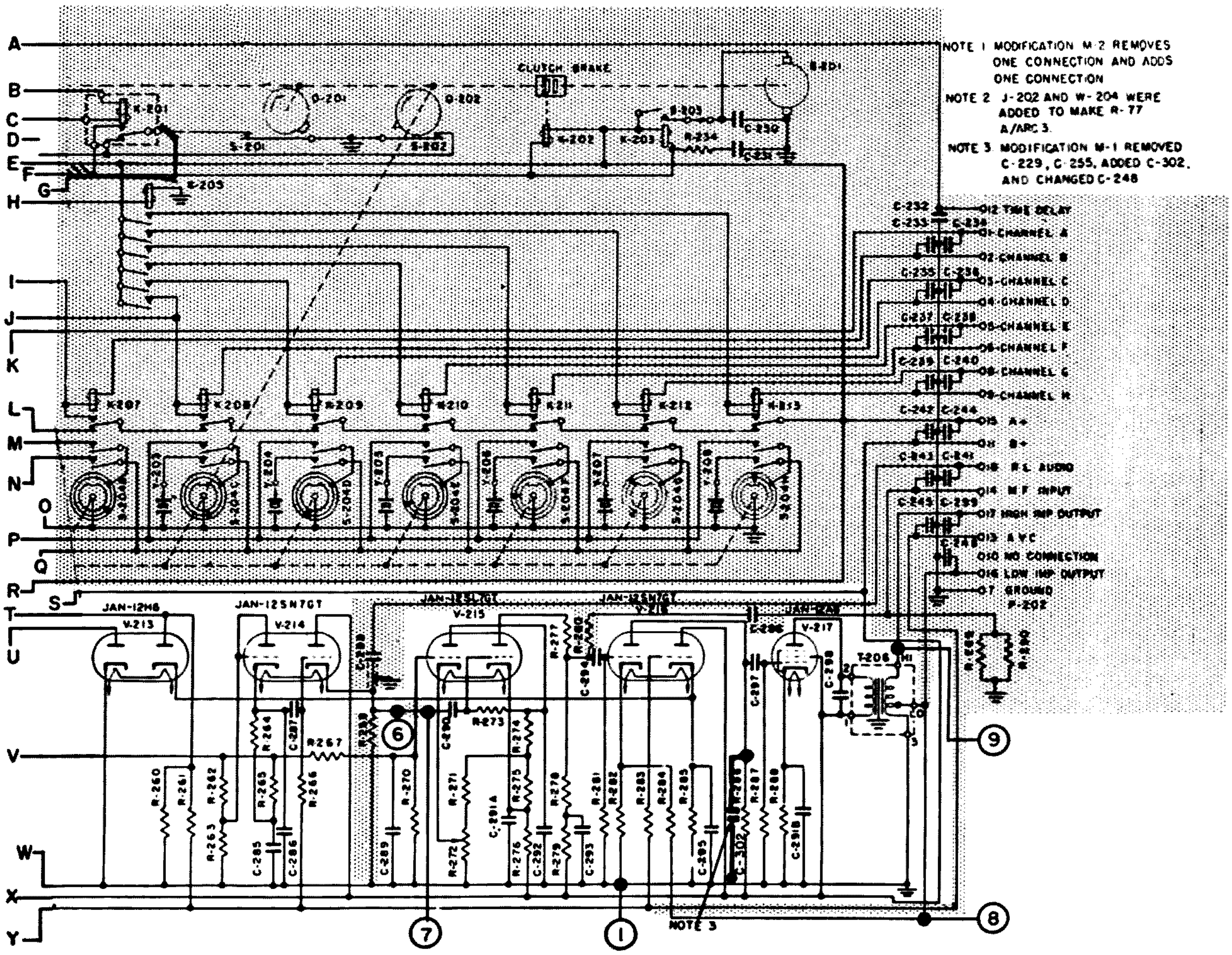
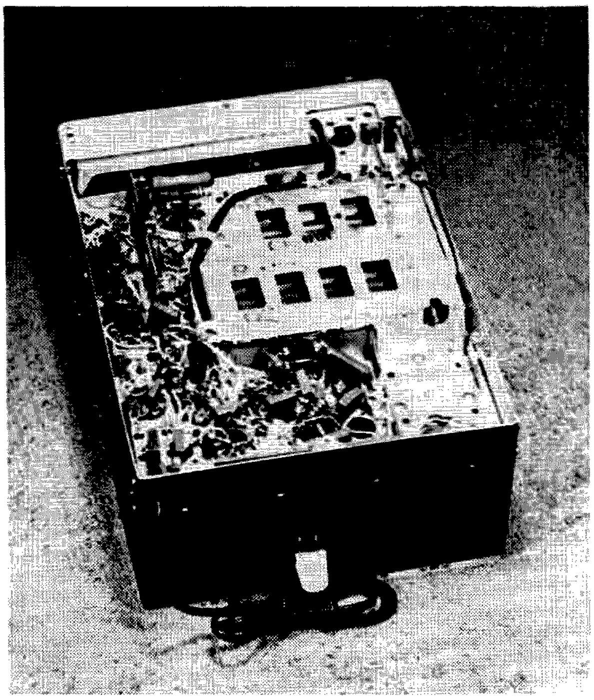

NOTE 1 MODIFICATION M-2 REMOVES ONE CONNECTION AND ADDS ONE CONNECTION
NOTE 2 J-202 AND W-204 WERE ADDED TO MAKE R-77 A/ARC 3.
NOTE 3 MODIFICATION M-1 REMOVED C-229, C-255, ADDED C-302, AND CHANGED C-248
CLUTCH BRAKE
JAN-12H6
V-213
JAN-12SN7GT
V-214
V-215
V-217
NOTE 3
6
7
1
8
9



Bottom view of the converted receiver shows power supply components in the upper left corner of the chassis. Note that the tuning motor is removed.

plate.

Unsolder the two white wires from the drive motor terminal board. Solder these two wires together, insulate and dress next to the chassis. Remove and discard the following wiring:

From	Color Code	To
Junction R-234—K-202 Coil	White-Black-**Orange**	Pin 4, K-201
Pin 4, K-201	White-Black-**Orange**	Contact, K-203
Junction C-230—B-201	White-Brown-**Blue**	Contact, S-203
Contact, S-102	White-Brown-**Blue**	Contact, K-203
Coil, K-203—Contacts K-204 and K-205	White	R-201
Coil, K-204	White-Black-**Red**	Pin 3, K-201
Pin 3, K-201	White-Black-Red	Contact, S-202
Contact, S-201	White-Black	Pin 2, K-201
Pin 2, K-201	White	Contact, K-204
Contact, K-204	White-Black	Chassis Ground
Contact, K-204	White-Orange	**R-223**
Pin 5, K-201	Resistor **Lead**	**R-232**
Pin 1, K-201	White-Red	Pins 6 & 8, V-207
Pin 4, V-207	White-**Green**	**R-226**

Remove and discard the following parts, leaving other wiring undisturbed: Capacitor, C-231; relay K-201 and its socket; switches S-101, S-102 and S-103; and motor drive B-201 along with clutch, K-202.

Remove all hardware that mounts components to the front panel and the screws which secure the panel to the chassis. Remove the panel, drill out the rivets which hold the crystal door reinforcing strip in place and discard the strip. Cut the old panel as shown in Figure 1 and peen the extruded mounting for P-202 over to form a smooth surface. Sand or steel wool the old panel to a bright finish. Drill and cut the new face panel as shown in Figure 2. Make sure that the holes in the two panels register to allow mounting of the controls. Finish the new face panel in your favorite color and set both panels aside.

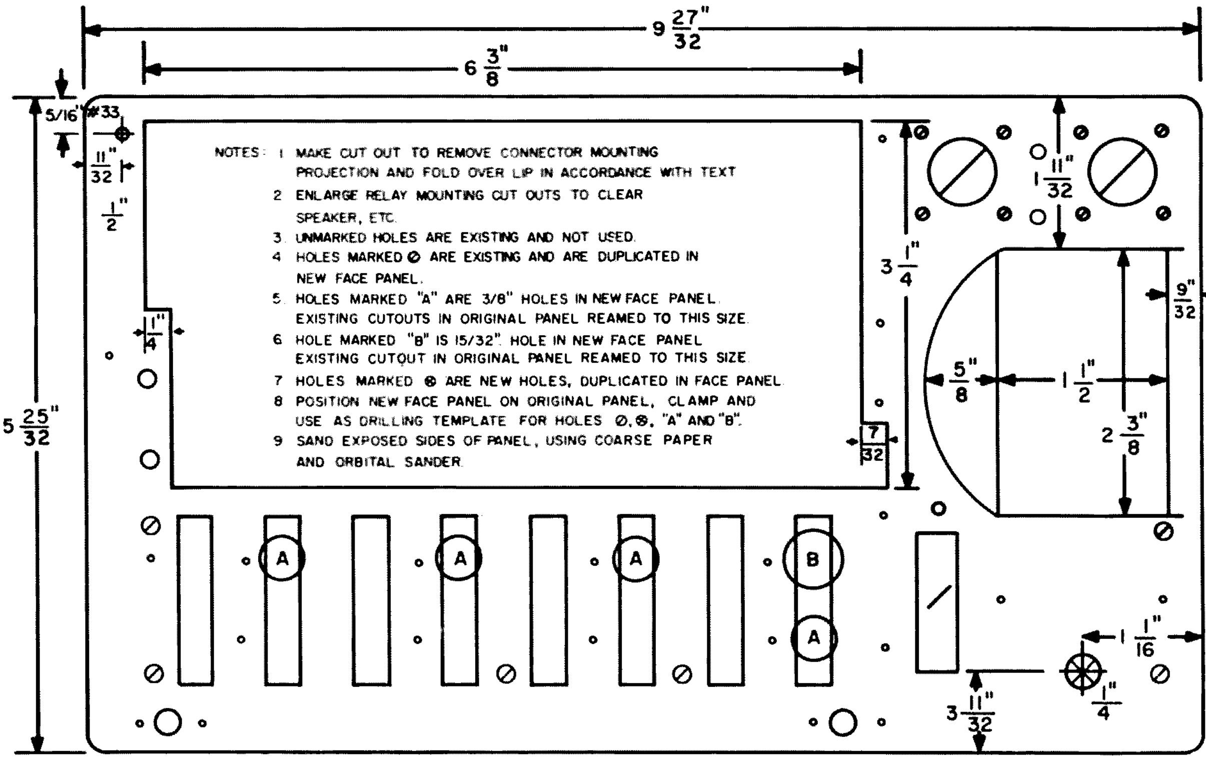


Fig. 1

BULLSEYE BUYS at ARROW!

R.C.A. POWER LINE MONITOR

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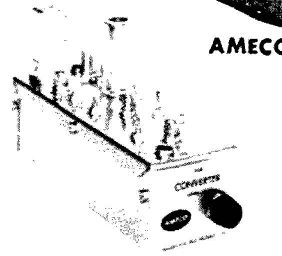
- Expanded Scale • 100 to 140 V. RMS
- Accuracy ±2% at 120 V., ±3% at 100 or 140 V.
- Large 4" meter face
- Convenient wall mount

Mod. WV-120A $14.95

AMECO NUVISTOR CONVERTERS



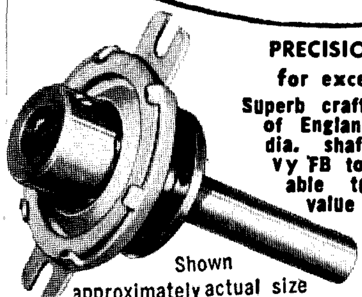
Choice of separate models for 50, 144 or 220 mc bands. Output frequency easily changed for present and future requirements. Three RCA 6CW4 Nuvistors used, two as RF amps, one as mixer with 6J6 oscillator. Noise figure: 2.5 db for 50 mc model, 3.0 db for 144 mc, and 4.0 db for 220 mc model. Image, spurious and IF rejection better than 70 db. Power required: 100-150 V @ 30 ma, 6.3 V @ 1 amp.

Specify desired IF output for converter model selected.

Kit: CN-50K, CN-144K, or CN-220K, each $31.95

Wired & Tested: CN-50W, CN-144W or CN-220W, each $44.95

PRECISION PLANETARY-VERNIER



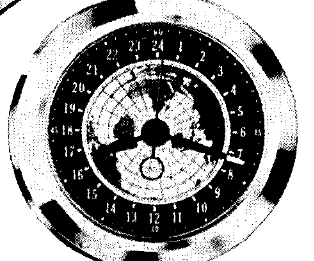
Shown approximately actual size

for exceptionally fine tuning

Superb craftsmanship by Jackson Bros. of England. Ball bearing drive, ¼" dia. shaft, 1⅛" long, 6:1 ratio, Vy FB for fine tuning. Easily adaptable to any shaft. Comparable value — $5.99.

Amateur Net $1.50 ea.
10 for $13.50

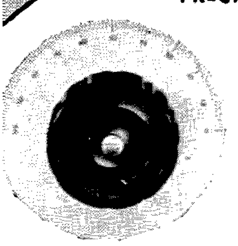
24 HOUR CLOCK



24 hr. chrome plated 8" metal wall clock. Inner dial with south polar projection map of world indicates time around world. Polar projection dial adjustable for various time zones. Shpg. wt. 2 lbs.

110 V. 60 cy. $8.47
12", 24 hr. clock,
110 V. 60 cy., without world map. $13.95

PRECISION BALL DRIVE DIAL



Another superb product of Jackson Bros. of England. 4" dia. dial with 6:1 ball drive ratio. Fits standard ¼" shaft. For that velvet touch . . .

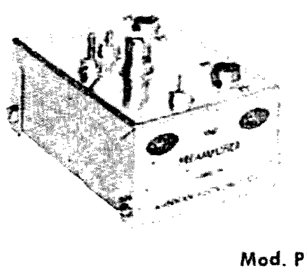
Amateur Net $3.95

COMANCHE SIGN

Controllable, illuminated sign that tells the XYL aad gaests you're traasmittiag. Cats down backgreaad BRM. Cao keek right iata coil ef antenaa change-over relay fer coatrelled "ON THE AIR" signal when XMTG. Heavy gaoge ail steel construction with haadsome black or gray kaked fiaish. Caa ke used en desk or tabletop or maunted directly aa wall. Dimeasiaas 10½" laag x 3½" high x 3" deep. Specify desired fiaish in klack or gray aad operating voltage: 6 or 12 VDC, ar 110 AC.

Amateur net $6.95

AMECO NUVISTOR PREAMPLIFIER



FOR 50, 144 or 220 mc. Over 20 db gain plus a lower noise figure, 2 tuned ckts, 6CW4 Nuvistor completely neutralized. Noise figure is 2.5 db @ 50 mc, 3.0 db @ 144 mc and 4.0 db @ 220 mc. Power requirements: 100-150 v. @ 8 ma, and 6.3 v. at .13 amps. Specify frequency desired.

Mod. PV, wired and tested $13.95

MAIL ORDERS PROMPTLY PROCESSED
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TO SAVE C.O.D. CHARGES, PLEASE INCLUDE SUFFICIENT POSTAGE WITH YOUR ORDER. ANY EXTRA MONEY WILL BE RETURNED.

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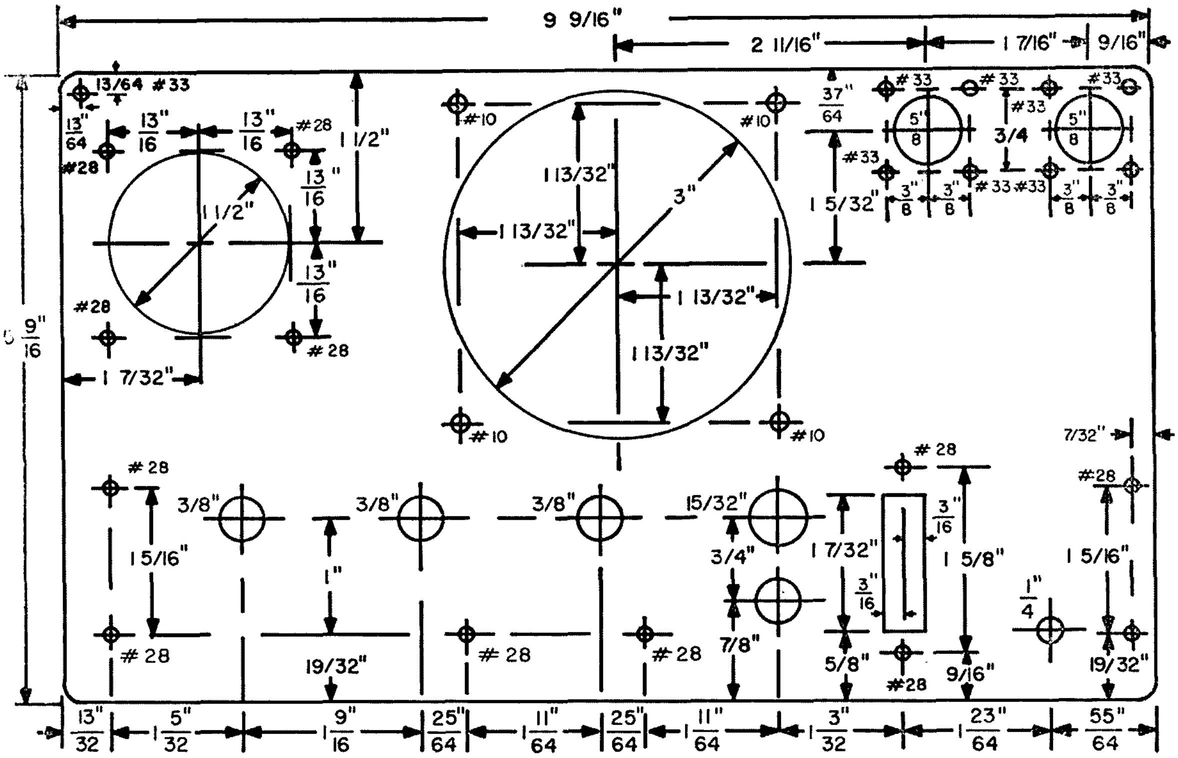


MATERIAL: 16 GAUGE ALUMINUM
FINISH: MACHINE SAND BOTH SIDES. PRIME AND APPLY TWO COATS FLAT BLACK LACQUER TO FRONT ONLY.

Fig. 2

Clip the 8 leads running between the crystal sockets and their respective relays and discard the socket. Cut out and discard capacitors C-233 through C-240 and clip the leads attached to pins 1, 2, 3, 4, 5, 6, 8 and 9 of P-202. Of the two white leads attached to pin 15, clip the one that runs to a contact of K-213. Clip and remove the 8 leads running between the relay bank and the selector switch. Unsolder the green and white lead from pin 6 of V-201, along with one end of capacitor C-208. Clip the other lead of this capacitor and discard. Remove the screws mounting relays K-203, K-204 and K-205 and clip the single ground lead still attached to these relays. Leave the cable intact that is connected to the relays and discard all 11 relays.

Loosen the set screws which secure the flexible shaft to the selector switch-dial assembly. Remove and retain the worm gear drive and mounting screws. Loosen the set screws holding the spring-loaded gear, shaft collar and the 8 switch rotors. Slide out the shaft and retain along with the spring washer, shaft collar and dial drum. Discard the 8 switch rotors; remove and discard the 8 switch stators. Reassemble the shaft, dial drum, shaft collar and spring washer in their original positions.

Remove the nut retaining the worm gear, saving the ball bearings. Drill ou the front end of the mounting bracket to clear a 3/16" shaft. Form the end of a 7/8" length of 3/16" brass rod to fit the recess in the front end of the gear. Tin both parts, clamp in alignment and sweat solder the shaft in place. Install spacer washers between the front of the gear and the bracket to place the gear in its original position. Place the bearings in the retaining nut, securing them in place with a smear of grease. Install the nut in position, tightening so that the shaft turns easily without excessive play. Re-install the gear assembly on the bracket, properly meshing the spring-loaded gear. Set the assembly aside.

On connector P202, cut loose and discard capacitors C-232, C-241, C-242, C-243, C-244, C-245, C-246 and C-299. Slit the lacing on the cable leading from P-202 to the point where it is clamped to the chassis. Remove and discard the white-brown-orange lead running from pin 12 of P-202 to pin 2 of V-207. Clip the white lead attached to pin 15 of P-202, pull through the wiring harness and coil in the vicinity of V-207 socket for future 24 volt ac connection. Remove and discard the white-brown-brown lead running between pin 13 of P-202 and pin 8 of R-291.

Remove and discard the white-brown-red lead which runs between pin 14 of P-202 and the junction of R-289, R-290 and C-296. Remove and discard these components along with the chassis ground lead connected to R-289 and R-290. Remove and discard R-280 along with the white-orange lead which was connected to C-296. Clip the white-red lead attached to pin 11 of P-202 and pull through the wiring har-

ness to where it terminates at the junction of R-223 and R-233. Coil the lead at this point and retain for future B+ connection.

Clip the white-brown-blue lead attached to pin 16 of P-202 and coil in the vicinity of the cable clamp for future loudspeaker connection. Clip the white-black-brown lead attached to pin 17 of P-202 and coil in the same location for future phone jack connection. Clip the shielded lead attached to C-288, discarding C-288, its mounting bracket and P-202. Pull the shielded lead through the wiring harness to where it terminates at C-290. Unsolder and discard this lead.

Remove resistor R-291 from its socket and insert a blank plug to prevent future, inadvertent use of the socket. Unsolder the white-brown lead from pin 7 of V-207 and connect to pin 2 of R-291 socket. Remove the white-brown lead running from pin 7 of R-291 to pin 7 of V-214. Install a 75 ohm, 4 watt resistor between pins 2 and 7 of V-210. Discard V-207 and clean up the socket for installation of a plug-in filter capacitor.

Remove and discard R-268 which is connected between pin 3 of V-214 and ground. Unsolder the white-orange lead which joins pin 3 of V-214 and C-290 from C-290 and connect to the terminal board pin to which R-280 was formerly terminated. Connect a two conductor, shielded cable, one lead to this point and the other to C-290, and route to the front panel

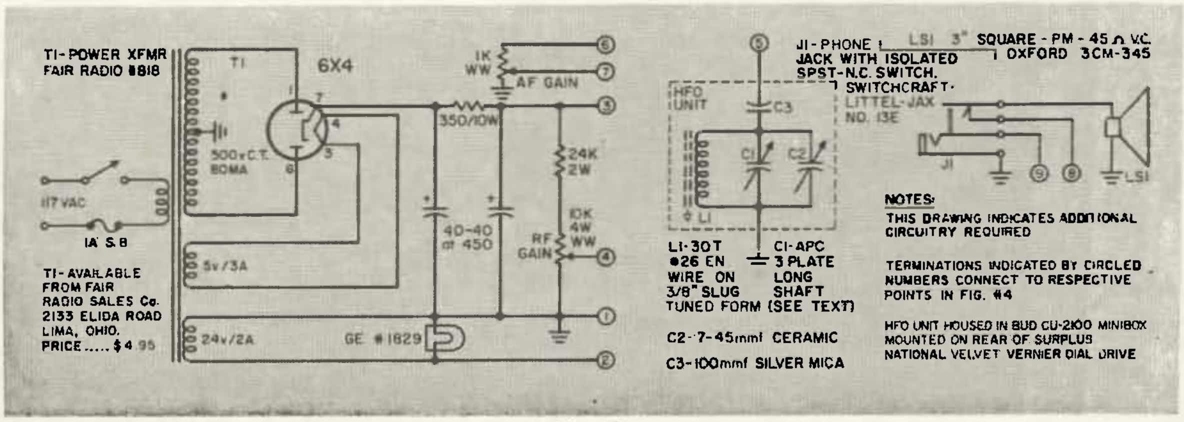
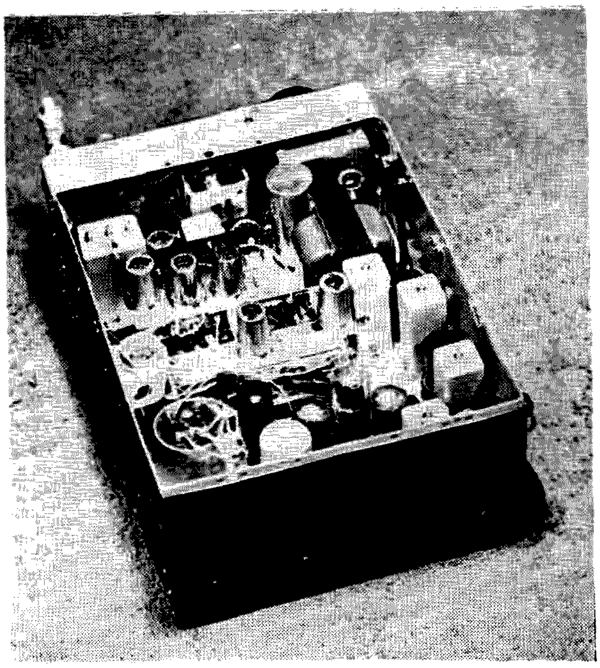


Fig. 4



Top view of the converted receiver shows the HFO box and the speaker mounted on the front panel. Power supply components are mounted in the upper right corner of the chassis.

area for future audio gain control connection.

Lift the ground lead of the rf stage cathode resistor, R-236, and connect to an insulated wire. Route this lead through an existing cable run to the vicinity of the front panel for future rf gain control connection. This completes the preparatory work on the chassis and we are now ready for the new wiring.

The first step is to mount and wire the ac power supply components. The Fair Radio Company power transformer specified in Figure 4 is designed for surplus conversions and its use greatly simplifies such jobs as this. Mount the power transformer, the 6X4 socket, the fuse holder and the other components in the general areas shown in the photographs. If a plug-in filter capacitor is available, it may be installed in the empty V-207 socket. Otherwise, remove the socket and install a twist-lock type capacitor.

Drill a clearance hole in the back of the case for the power cord and wire the power supply in accordance with Figure 4, making interconnection to the previously mentioned B+ and 24 volt ac points. Route the ac switch leads to the vicinity of the front panel, along with a 24 volt ac lead for the pilot light.

Place the new finish plate over the old front panel and mount all components except the HFO dial assembly in the locations shown in the photograph. Note that the squelch control is replaced by a standard shaft, 1,000 ohm control. Mount the modified selector switch-dial assembly in its former location and install a bayonet type socket with a #1829 lamp so as to illuminate the dial scale. Remove the knob from the top of the old tuning drive motor and install on the new shaft which extends through the front panel.

Wire and ground to the panel all common ground points of the panel mounted components and install the lead between the phone jack switch and the speaker. The 45 ohm voice coil speaker provides a reasonable match to the 30 ohm output tap and saves the cost of a line matching transformer.

The new HF oscillator tuning assembly should now be constructed. The dial drive is a National Velvet Vernier unit salvaged from a surplus tuning unit and fitted with a scale from the junk box. A Bud Minibox is supported on standoff posts from the rear of the drive. The tuning capacitor, a 3 plate APC unit with a ¼" shaft, is installed in the top-center of the box and sub-mounted ⅜". Mount the capacitor and drill 4 holes in the top of the box to match the drive unit mounting holes.

Mate the capacitor shaft with the dial drive coupler and mount 4 internally threaded standoff posts of appropriate length to the front of the box. Set the capacitor to maximum capacity and the tuning dial to 100. Press the posts firmly against the rear of the drive unit and tighten the coupler set screws. The assembly will be mounted by screws running through the front panel, the dial drive flange and threaded into the standoff posts. Mount the coil form and the ceramic trimmer capacitor, drilling clearance holes for adjustment. Drill a hole in the right end of the box to pass the grid lead.

Decision must now be made as to the projected frequency coverage of the converted receiver. Crystals in the range of 8,000 to 8,727 kc were used in the original circuit and full coverage obtained by using various harmonics in accordance with the following chart:

Air Frequency (mc)	*Crystal Harmonic*
100-108	11
108-116	12
116-124	13
124-132	14
132-140	15
140-148	16
148-156	17

If you are content with the 2 meter band spread over 30% of the HFO dial, then full coverage from 100 to 156 mc may be obtained by making the grid circuit tune from 8,000 to 8,727 kc. If you desire maximum bandspread on 2 meters and are not interested in other coverage, then construct the unit to tune from 8,250 to 8,500 kc. Wind the coil and wire the circuit as shown in Figure 5. Extend a heavy, solid conductor wire for the grid connection. Using a grid dip meter, juggle the coil slug and trimmer capacitor to obtain the desired coverage. Number of coil turns and tuning capacitor plate spacing may also have to be adjusted. Final adjustments must be made

after the set is working.

Install the cover on the HFO unit and mount on the front panel. Position the panel assembly at the front of the chassis and wire the components in accordance with Figures 3 and 4. Install the wrap-around sides and back, using the original hardware. Slide the panel into final position, engaging the flexible shaft in the coupler. Install the panel mounting screws. Set the capacitor gang to minimum capacity, the dial drum to 156 and tighten the coupler set screws.

Inspect your work, make an ohmmeter check and, if all is well, apply power. Tune in the high frequency oscillator signal on a local receiver and touch up the coil slug and trimmer capacitor to give the desired coverage. The HFO dial scale may be calibrated directly or calibration charts made up. In either case, determine the proper harmonic from the preceding chart and apply the following formula to determine the HFO setting:

$$\text{HFO FREQUENCY} = \frac{\text{AIR FREQUENCY}-12\text{MC}}{\text{HFO HARMONIC}}$$

Connect an antenna, advance the gain controls and the squelch and you should be in business. Set the HFO and the capacitor gang to the desired frequency and then touch up the capacitor gang tuning for a noise peak. Signals should be received with good volume and excellent quality. If 2 meter activity is limited in your area, the 100 to 108 mc segment of the FM broadcast band is a good place to get the feel of the receiver. Slope detection of the FM signals results in amazingly good quality. In normal use, set the HFO to the desired frequency and use the capacitor gang tuning control as you would an antenna trimmer.

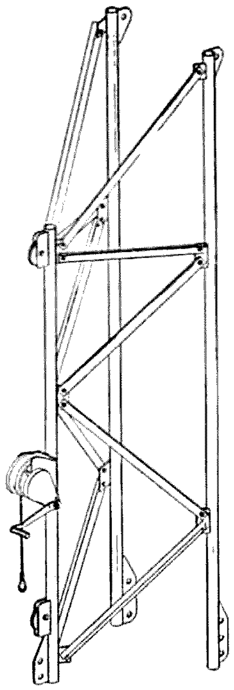
Attractive, functional control knobs and commercial decals dress up the equipment and give that commercial appearance. In the unit shown in the photographs, the wrap-around cover was given a coat of flat black, spray lacquer. This contrasts nicely with the bright aluminum sides of the original panel.

Other refinements may be added as desired. A cascode preamplifier would undoubtedly improve the signal to noise ratio and provide more gain. A touch up of the alignment, both rf and *if* is definitely recommended and may be accomplished on a weak signal in the most used portion of the band. If the audio gain is considered inadequate, it may be substantially improved by removing the inverse feedback resistor, R-284.

All in all, this is a very satisfactory conversion. There is lots of work involved but the low initial cost compensates for that. While not a "hot" receiver, the stability and reliability, effective noise limiter and the overall performance make it FB for local work.

. . . W4WKM

New Product



New two way hinge over base.

Starting with the tower lying flat on the ground, one man can hoist this husky, self-supporting TRI-EX tower without the help of half the neighborhood or a crane. The secret is a new two-way-hinge-over pilot base which works so slick you will "ooh" and "ah" when you see it. After the initial hoisting job, the tower pivots on the higher point of the two-way base and can be raised and lowered for antenna adjustments just as easily as cranking up the old Model T. And this is a hefty tower, too, all first class hardware. Another feature that insures maximum tower strength at any given height is the fact that as the tower rises, the telescoped sections space out *evenly*, that is, maintaining uniform overlap and therefore uniform tower strength. Neat, huh? Minimum overlap 3' with precision fitting for maximum rigidity. All sections are heavily built and the top section (13⅞") will accommodate large rotators. Tower can be any height you wish, up to maximum, as large heavy duty raising/lowering cable renders "stops" unnecessary. Take a look at one, or send for their literature. It's in that rare class of hardware that's an aesthetic pleasure just to see, or to watch in operation. *Really*, as the saying goes, *built.*

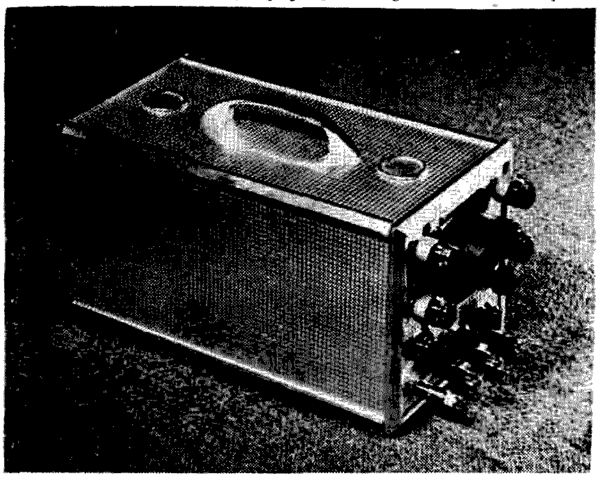
TRI-EX Tower Corporation, 2920 W. Magnolia Blvd., Burbank, Calif.

Sturdy, Professional Appearing Custom Equipment Housings Made From Readily Available Materials, Using Woodworking Tools and Techniques. "Post and Plate" Construction Method Eliminates the Chassis Problem and Makes for Easy Assembly.

Economical Custom Construction

Roy E. Pafenberg W4WKM
709 North Oakland Street
Arlington, Virginia

Photography by: Morgan S. Gassman, Jr.



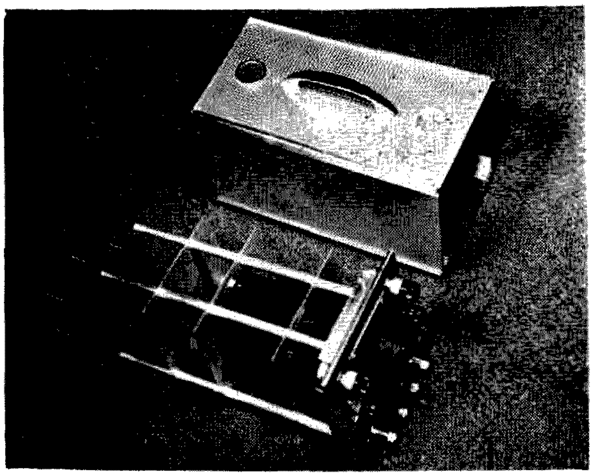
This compact scope unit is an example of construction using the techniques developed in the text.

WHILE an ever increasing number of electronic equipment cabinets are reaching the market, it seems that the exact size and style to suit the immediate construction project is never available. While the modular type housings provide an answer, the current prices on these items preclude their use in many amateur construction projects. On the other hand, if an enclosure is on hand to house the particular circuitry envisioned, the ugly problem of locating a suitable chassis takes over.

The obvious answer to both the chassis and cabinet problem is to build your own. However, we are not all experienced sheet metal workers and, even if we were, lack of suitable machinery can make the work very difficult. The photographs show a harmoniously compatable solution to both problems. Cabinet construction uses rectangular panels of laminated hardboard and "do it yourself" aluminum, rigidly secured by slip fit, interlocking sections of outside corner, tileboard moulding. The "post and plate" technique of assembly solves the chassis problem by eliminating the conventional chassis and using easily fabricated aluminum plates supported from the panel surface by standoff posts.

The cabinet panels are made of ⅛" tempered masonite which has .02" embossed sheet aluminum bonded with contact cement to what is normally the back side of the hardboard. The aluminum used is Reynolds Metals Company "do it yourself" stock which is available in all hardware stores. The stock shown in the photographs is Reynolds #28 square embossed pattern and is priced at $2.99 per .02" thick, 36" x 36" sheet. Other styles, available at the same price and appropriate to this method of construction, are the #1 plain aluminum, #2 leather grain embossed, #27 wood grain embossed and the #33 lincane perforated sheet.

The tempered masonite is smooth on one side and rough on the other. Since the aluminum extrusions are designed for use with ⅛" thick material, it is necessary to remove stock from the rough side of the hardboard equal in thickness to the aluminum sheet and contact cement used for bonding the laminate. When the material is purchased, have the lumber yard run the masonite through a planer and make a 1/32" cut on the rough side. Some static may develop to the effect that the masonite is super-hard and the planer blades would be ruined on the job. This is not true. The reverse side of the tempered masonite is little more than fuzz to the indicated depth and a perfectly smooth surface results with none of the vibration or noise symptomatic of equipment abuse. Many lumber yards will make the planer cut at no cost in the interests of good



Scope foundation unit uses "post and plate" construction described in text. Screws through the back of the cabinet are threaded into the posts and clamp the cabinet together.

will. If not, the charge will be nominal.

The most economical panel size will be dependent on the capacity of the planer. Since the masonite is available in 2′ x 4′ panels at around $1.00 per sheet and 24″ is the maximum capacity of many planers, this is probably the size you should buy. Cut, or have cut at the time of purchase, the planed masonite in two pieces, 2′ x 3′ and 1′ x 2′. Cut a sheet of aluminum to the same sizes and retain the 1′ square piece for future projects. The aluminum is soft and may be cut with tin snips or, according to Reynolds, with household shears. Roughen the back side of the aluminum with coarse sandpaper and apply contact cement to this surface and to the back side of the masonite. There is nothing difficult in the use of this adhesive but the instructions on the container must be followed to the letter.

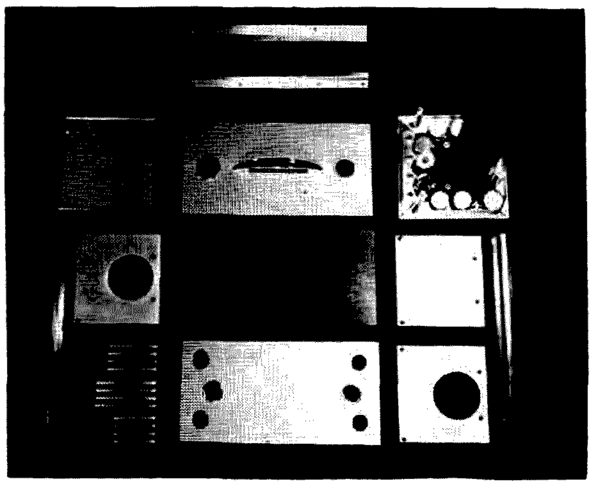
When the cement is thoroughly dry, position the aluminum over the hardboard and press together. Be careful. Once the two prepared surfaces meet, they can not be separated. Follow the paper slip technique described on the cement container and all will be well. After the work is in position and the paper removed, roll the aluminum surface with a rolling pin to insure a good bond. You are now the proud possessor of 8 square feet of laminated cabinet panel material.

The laminated material may be treated from this point on as if it were ordinary masonite. Common woodworking tools and techniques apply. Always work with the aluminum up when sawing. When planing and filing, exert the tool pressure from the aluminum toward the masonite to avoid separating the bond. While a hand saw may be used to cut the panels to the desired sizes, a table saw with a cabinet combination blade will cut the panels so smoothly that no further edge finishing of any kind will be required.

A few words are now in order on the proportions and dimensional relationships of cabinets assembled from the laminate and the outside corner aluminum extrusions shown in the photographs. The front and back panels are framed with mitered lengths of the aluminum extrusion which are slipped over the edges of the panels and secured in position with machine screws and/or panel mounted components. The top, bottom and side panels are slipped into side rails made from the extrusion and are, in the final assembly, ridigly clamped in position by the interlocking angles secured to the front and rear panels.

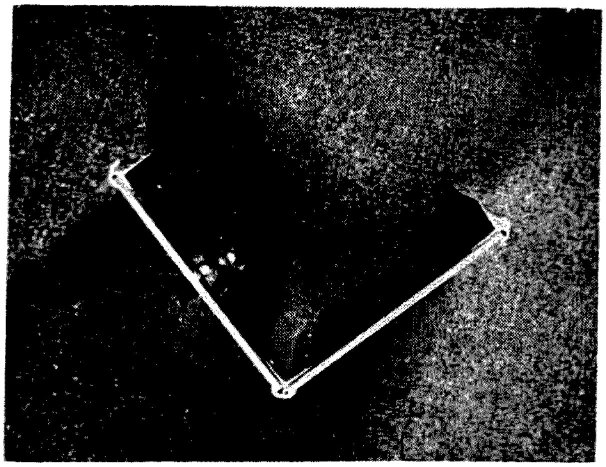
The aluminum extrusion is so proportioned that the *inside* dimensions of the finished cabinet will exactly equal the size of the panel used in each plane. The height of the front and back should equal the height of the side panels; the width of the front and back should equal the width of the top and bottom panels; the length of the top, bottom and side panels should be the same and will be the inside depth of the cabinet. The outside dimensions of the finished cabinet will, including the projections of the corner extrusions, equal the size of the panels used plus ½″.

The extrusion used is polished aluminum outside corner trim moulding designed for use with ⅛″ tile or tileboard. The moulding is widely available and sells for less than $2.00 per 8′ length. The photograph shows the methods used in mitering the moulding. A small miter box is employed and a piece of ¾″ plywood is cut to fit the bottom of the box and slotted to hold the aluminum extrusion at the proper angle. Both angle and straight cuts are easily made with this arrangement and a fine tooth hacksaw. A couple of swipes on a sheet of sandpaper will remove the burrs. The notches for the butting angle clearances are easily made with another jig shown in the photograph. This is a rectangular piece of ¾″ plywood with a similar slot located near one edge and two short slots in either end to guide the hacksaw blade. A right angle slot is cut near the center of the jig to complete the cutout required at the mitered corners.



These modular elements comprise the complete cabinet.

The aluminum trim, as supplied, is formed to angle slightly less than 90°. This is to allow it to be tapped into place and provide a perfect fit with the contour of the work. The 100° angle sawed on the edge of the other jig shown in the photograph is used to shape the extrusions for a snug fit at the panel junctions. Two 40° cuts on a table saw will complete the jig. To form the 100° angle in the extrusion, place the open side of the angle over the beveled edge of the jig, place a wood block over the aluminum to protect the surface and tap lightly with a hammer.

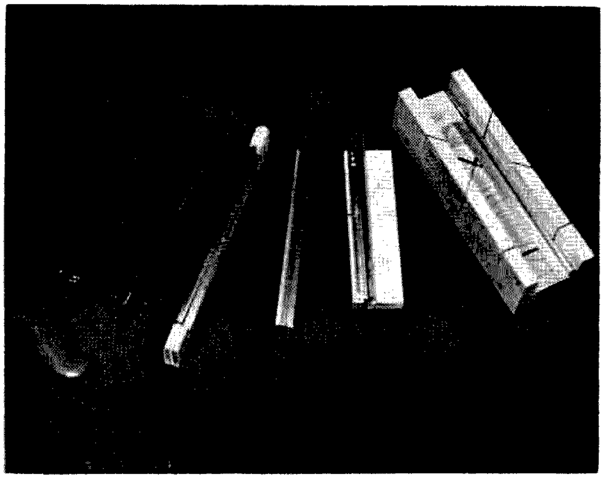


"End on" view showing how the laminated stock assembles in the outside corner aluminum trim.

Ventilation of the inclosure should receive early consideration. If solid panels are used throughout, screened type hole plugs such as those shown may be used. Aluminum eyelets are also suitable and will provide a professional appearance. The article by John Howard, "Aluminum Eyelets Make Good Fever Medicine," which appeared in the September, 1960 issue of QST, describes the technique. Holes for this and other purposes are easily bored with a brace and wood bit. A standard expansion bit may be used for the larger holes. Drill from the aluminum side and back up the masonite with scrap wood.

If the equipment dissipates a great deal of heat, perforated stock should probably be used for one or more of the cabinet surfaces. Reynolds #33, lincane pattern perforated stock provides 43% free air space and, if properly framed, is sufficiently rigid for the average size panel. A frame of ⅛" x ¾" flat bar stock, Reynolds #4, should be carefully mitered to the exact size of the desired panel. Secure the frame to the inside surface of the perforated stock, cut to the same size, with ⅛", #4 or #6, round or binding head machine screws tapped into the bar. These screws should be located about ⅜" in from the edge of the panel to clear the retaining lip of the extrusion.

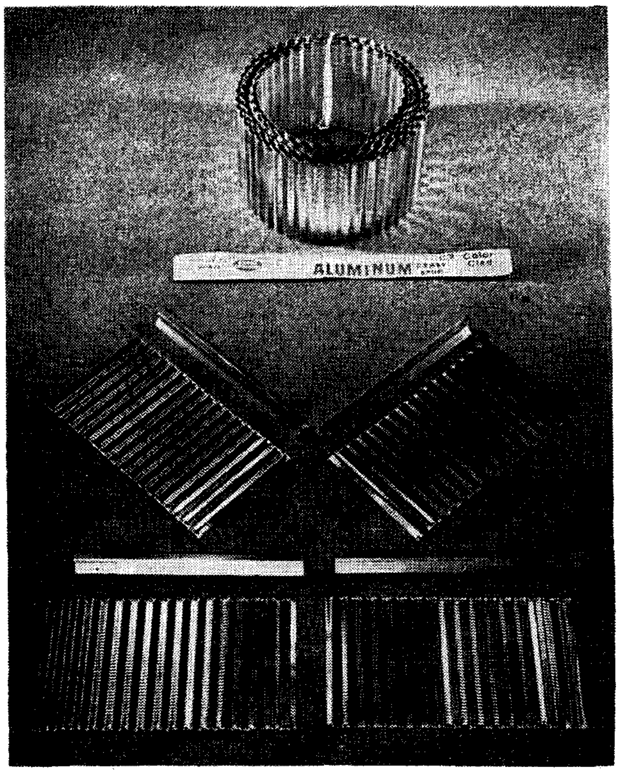
After the component parts of the cabinet are completed, refinements such as mounting feet and carrying handles may be added. Though this is a matter of taste and actual requirement, the photographs show the methods used. Finish is also a matter of personal taste. The polished aluminum extrusions require no finish and, as supplied, dress up the finished product. The embossed aluminum, in all styles, has an attractive luster and, unless desired, requires no further treatment. The same is true of the lincane pattern perforated stock. The plain aluminum sheet, which is ideal for panels where marking decals are required, will require finishing. The spray lacquers, available in pressurized cans, are ideal for this purpose. Clean the metal with solvent, roughen the surface with very fine sandpaper and apply a coat of zinc chromate primer. Krylon No. 1319 and Krylon No. 1320 are both suitable. Allow to dry, wipe off the dust and apply the finish coats. Matching or contrasting colors may be used on the various panels. A wide range of colors is available and factory appearance is easy to achieve.



Jigs and tools used to work the aluminum extrusion. While not essential, they speed up and improve the quality of the work.

Considerable variation is possible in the type of panels used. Styles may be the same or mixed, depending on the effect desired. The photographs show one extreme case. Side panels are cut from green anodized, heavy weight, corrugated aluminum lawn edging which is available from Sears Roebuck and other hardware outlets. This stock is sold in 20, 30 and 40 foot rolls in 2, 4, 6 and 8 inch widths. The corrugations are compressed to fit in the slots in the extrusions and the lengths are made such that, in the final assembly, considerable end pressure is exerted. The result is a lightweight, stressed aluminum housing that is amazingly strong for the thing gauge stock used. The reverse side is not colored so that the panels may be reversed or painted for contrasting color effects.

The small oscilloscope foundation shown in the photographs is an ideal example of the cabinet problem, the custom approach and the techniques used. The writer has a require-



Corrugated aluminum lawn edging can be used for the side panels in this version of the cabinet. End clamping the sheets stresses the light stock and gives strength.

ment for a small, portable scope. While the kits provide an answer, the physically smaller kits and commercially manufactured scopes are prohibitively priced. The obvious answer is to build the instrument from scratch. Here the problems really start. No line of commercial cabinets is available in the configuration ideally suited to oscilloscope construction. Further, the scope is one instrument that does not lend itself to the conventional front panel and chassis pan approach.

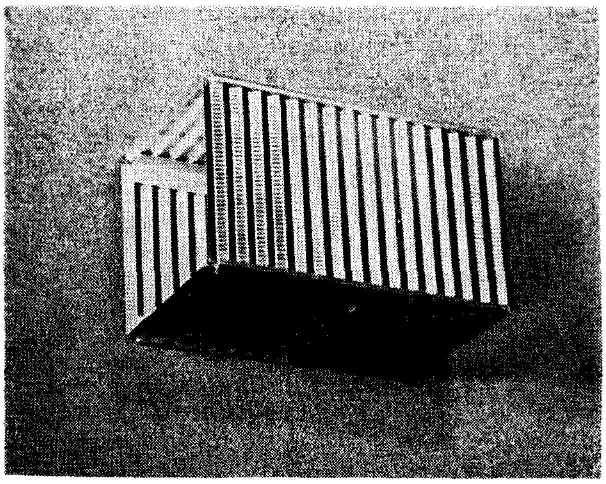
The "post and plate" method of chassis construction is adaptable to commercial cabinets, standard relay rack panels and the enclosures described herein. Flat component mounting plates are supported from the rear of the front panel by standoff posts. As many decks may be used as the complexity of the equipment warrants. The material used for the plates may be flat aluminum, insulation stock or perforated Vector circuit board if that method of assembly is preferred.

An ideal material for the standoff posts is Reynolds ⅜" round aluminum rod. This material is easy to work, sufficiently strong for most jobs and may be found in any hardware store. While the rod may be cut to size, dressed square, drilled and tapped with hand tools, access to a metal turning lathe makes the job so much easier. Turn to size, drill each end of the posts with a number 21 drill and tap to a depth of about ¾" with a 10-32 tap.

The rectangular component mounting plates are cut from sheet aluminum stock. While sheet aluminum in the required thickness is a bit more difficult to locate than the consumer packaged Reynolds products, no real problems should be encountered. Since the dimensions are small, as contrasted to the stock required for an equivalent chassis pan, scrap stock may often be used. Since no bending is required, the harder grades of aluminum are suitable and will give greater strength. Hole drilling and cutting is a snap as no close quarter work is involved in working with the flat plates. Clearance holes may be used to clear components protruding from adjacent decks and will permit close stacking. The photographs show this treatment of the scope tube shield. After all drilling and cutting is completed, an attractive finish may be given the plates by sanding with coarse grit paper or cloth in an orbital sander. This will give a "General Radio" type finish that may be further enhanced by etching.

Wiring of the plates is easy if most of the work is done prior to assembly. If stacked component mounting plates are used, bring all interconnecting wiring to one edge of the plates. If this technique is followed, the wiring may be completed and maintenance performed by loosening the spacers and opening the plates up like the leaves of a book. Of course, if plenty of space is available, use long standoff posts and full accessibility can be obtained without disassembly.

Use of the construction techniques described above can result in equipment that will be a continuing source of pride to the builder. There is, of course, work involved. However, far less effort and skill are required than if conventional methods are used. Care in cutting



The corrugated stock assembled in the side rails forms the top, sides and bottom in this variation of the enclosure.

the miters in the extrusions is a must for decent appearance. Otherwise, no particular attention is necessary because all worked edges are concealed by the trim. Try this construction method and enjoy the freedom of not being bound to the dimensions of stock cabinets.

. . . Pafenberg

Jim Kyle K5JKX/6
1851 Stanford Avenue
Santa Susana, Calif.

Avoid Precise Inaccuracy

SOME years ago, the noted British scientist Lord Kelvin declared that, to be able to discuss a result or to work with it in any way, you first must be able to put it in numbers.

Nowhere is this more true than in radio measurements. Sometimes, in fact, we tend to be slightly exhuberant about "Putting it in numbers," as witness the number of "60 db over S-9" signal reports being bandied about!

Unfortunately, much of our test equipment is just about as accurate as that notorious signal report. Sure, we can tell whether we have 10 or 100 volts at a given test point—but can *you* say with assurance that the voltage at that point is 19, rather than 18 or 20? If you can, you have a most extraordinary meter!

"But I calibrated the meter just like the book said," you may reply. We aren't disputing your word. However, the usual calibration procedures issued by kit makers and instrument manufacturers don't guarantee extreme accuracy or precision.

There's nothing wrong with the procedure, but one important fact is often overlooked: the calibration can't be any more accurate than the standard source you use.

Many otherwise- conscientious hams follow a slightly confused course of reasoning at this stage. "If the meter is only accurate to 3 percent," they say, "then the calibration standard I use doesn't need to be any more accurate than 3 percent either. The meter won't be able to tell the difference."

A few minutes' work with some actual figures will soon show you that the standard-voltage source you use for calibrating a meter has to be absolutely accurate if you hope to get the 3-percent accuracy the meter movement is capable of:

Suppose that the meter's full-scale reading is 3 volts, a common value. That means that its accuracy is ±0.09 volt if calibration is exact. If the meter is calibrated to absolute accuracy, and reads 1.5 volts, you know that it's measuring a voltage somewhere between 1.41 and 1.59 volts.

Now let's suppose that you're calibrating the meter for the first time, and in accordance with the kit-makers instructions you're using a fresh size D flashlight cell as a voltage standard. The known voltage, says the kit-maker, is 1.561 volts. You adjust the calibration control until the needle points just to the right of the 1.56 mark, and the instrument is calibrated.

How closely?

The flashlight cell's exact accuracy is unknown, but is probably somewhat poorer than 5 percent. Let's suppose that it's 5 percent low, and let's suppose still farther that your meter's error at this exact point on the scale is the full 3 percent, on the high side.

Your true standard voltage was 1.553 volts, instead of the 1.561 you thought it was. In addition the meter introduced its own 0.09-volt error. Effect of the meter error was to indicate a voltage 0.09 volts greater than the actual voltage. You set the needle to read 1.561 with a 1.553 volt input. Pretty close. Now put an accurate 2-volt source onto the meter, and read the result as 1.892 volts if all the errors jump to the other side. Not so good, eh? Nearly 10 percent error!

If all the small-voltage differences seem to you like splitting hairs for no good cause, reflect a moment. Most kit-type meters are calibrated at 1½ volts with a size D cell, and that calibration is expected to hold true *for all other ranges.*

Following up our earlier example, suppose we switch ranges to the 1000-volt scale to measure the output voltage of a power supply for a 100-watt transmitter. We read 550 volts under load.

But what's our accuracy?

The original calibration involved a 5 percent error from the standard used, plus a 3-percent meter error. This makes 8 percent error in calibration. Add 3 percent for the meter again (we switched scales, remember?) and we have more than 10 percent error. This 10 percent error must be multiplied by the full-scale reading to find the probable error in volts; the answer is 100 volts.

So our reading of 550 volts means that the actual voltage is somewhere between 450 and 650 volts—and the 600-volt capacitors in the power supply may suddenly explode from overvoltage despite that fact that you measured the unit out well under ratings!

Let's suppose some more. Switch up to the 3000-volt scale to read the input to your KW

final. Read it out as 2,500 volts on the nose. Measure the voltage drop (using this same meter on the 100-volt scale) across a 100-ohm resistor in the B+ line, and by Ohm's law calculate the input at 400 ma.

Exactly one kilowatt. Nice and legal.

How's the error? Remember that 10 percent. Suppose it's all on the low-reading side. You actually had 2,800 volts going in, at 500 ma, for a total plate power input of 1,400 watts. The FCC was watching. What was your call?

We hope we've made our point about accuracy and precision. At this stage, your question should be, "But how do I get any better accuracy without spending a small fortune?"

One of the basic causes for error—which is easily corrected—is the assumption that a calibration made on one range will hold true for all other ranges. You can take a long stride toward better accuracy by calibrating each range of the instrument individually.

However, most instruments have only one calibration control, which affects all ranges. How can you calibrate them individually?

For a starting point, calibrate the highest range first instead of the lowest as you're normally told to do. Then check the calibration on each lower range, recording the error at each check point.

If you record each error as a percentage of full-scale, rather than as an absolute error in volts or what have you, you can readily see the average calibration error. Then all you have to do to reduce it to a minimum is to adjust the instrument to be *one half the average calibration error* toward perfection on any of its scales.

For instance, if the average calibration error is 4 percent in the low direction, and on the 300 volt calibration you read a 150-volt standard as 151 volts, you would set the meter to read 156 volts instead. You get this figure by taking half of the 4-percent low average error, or 2 percent low, of the 300-volt full-scale reading. Two percent of 300 is 6 volts, and the average error is on the low side, so you would set the instrument to read 6 volts higher than the standard.

Note that in this example the absolute error on the scale used was increased by the correction rather than reduced. However, a recheck of all scales would reveal that average calibration error had been reduced to almost zero, since as many scales would read high as would read low.

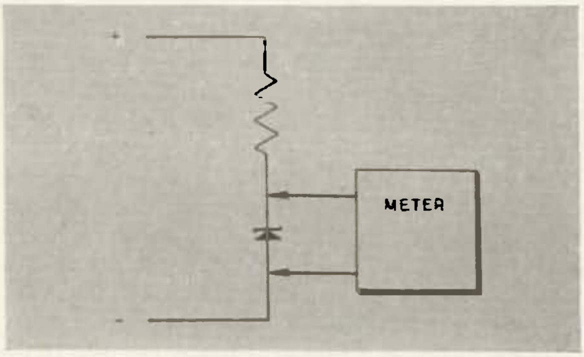
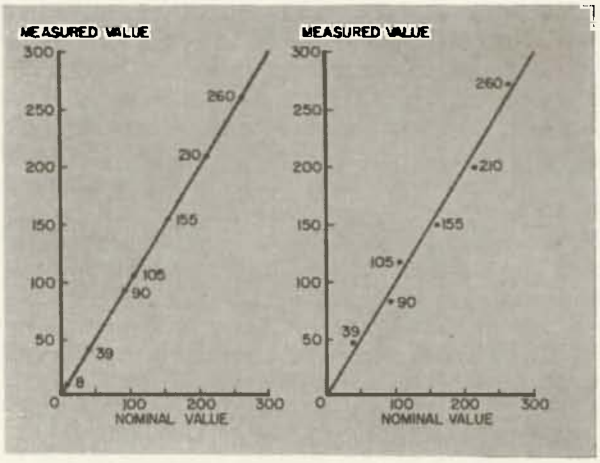


Fig. 1

If this approach doesn't appeal to you, your only recourse is to either calibrate the meter on the scale you use most often and prepare correction charts for other scales, or to redesign the meter to include separate calibration controls for every scale. Either route involves its difficulties.

So far, we've talked a lot about calibration standards but we haven't actually described anything of the sort. This brings us face to face with the question, "Where do we find a standard to check against?"



Figs. 2 and 3

If you're rich, you can buy a Weston Standard Cell, which delivers 1.08 volts at zero load (and will be instantly destroyed by any load) for about $100. This is the kind of standard the people at WWV use.

However, for ordinary usage, cheaper standards are available. Taking into account its probable 5-percent error, the size D flashlight cell is the least expensive and is accurate enough for calibration of 3-volt ranges on most meters.

If you want to be more accurate, though, a 1.5-volt nominal-rating mercury cell delivers 1.34 volts throughout its useful life; using one of them for a standard will bring you to the meter-imposed limit of accuracy on the 3-volt range, and 10 of them in series will give you the same accuracy on the 15- or 30-volt ranges.

At the other end of the scale, VR-tube voltage regulators provide a fair standard for the price. They are rated at 3 percent accuracy for their nominal voltages, and most are closer than that. Averaging out the readings from five tubes will bring you within one percent—but this is still a 1.5-volt error at 150 volts.

In between, Zener diodes offer accuracies to 1 percent at a high price, and to 5 percent at more reasonable figures.

One way of getting 1-percent accuracy at a

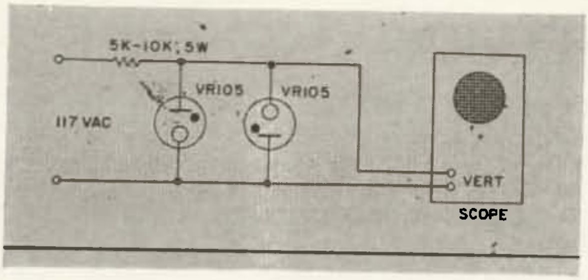


Fig. 4

5-percent price is by use of probability theory. Since it requires a large number of standards for each value, it's strictly a club-project type of operation. Here's how:

Suppose you want an absolutely accurate 39-volt standard. First you buy, beg, promote, borrow, or steal as many 39-volt Zener diodes as you can get (the same principle applies to VR tubes since the tolerances are tighter, you don't need so many of them).

If you get enough units, the laws of probability tell us that five percent of them will be within 2 percent of rated value and that 2½ percent of them will be within 1 percent.

Set up a test jig (Fig. 1 shows how), and measure the voltage across each diode in turn. Use the same meter on the same scale for all measurements to eliminate calibration errors. Then average out the readings. The average reading, minus the rated voltage of 39, is the meter error. If the average reading is 42 volts, the meter is reading 3 volts high.

Now, go back through the stack of diodes, still measuring with the same meter, until you find one which indicates exactly 42 volts. That one is your exact 39-volt standard diode. You can now return the other 999 units to the manufacturer for a refund.

Another meter calibration scheme which avoids the astronomical numbers of standards involved in the preceding idea is to plot a graph.

To do this, you use any standards you can scrounge. However, try to get standards which will produce readings at about the same point on the meter scale.

Measure each of the standards and record the readings. On ordinary graph paper, plot the nominal value of the standard on the horizontal scale and the measured value on the vertical scale.

If your meter and standards have no error, a line connecting the zero point and the plot of the highest standard measured should pass through every plot on the graph, as shown in Fig. 2. Naturally, in practice, it won't.

Stick a pin through your graph at the zero point, and swing a straightedge until you find the line which passes through the middle of the plots, leaving as many on one side as on the other, with about the same distance from the plots to the line on either side. Fig. 3 shows how.

Alternatively, if one of your standards is much more accurate than the rest, draw a line through the zero point and the accurate-standard plot and extend the line across the graph.

Now plot the points where the line you just drew crosses the *vertical* lines which correspond to the readings you recorded. Read back to the vertical scale to find the corrected values of your standards.

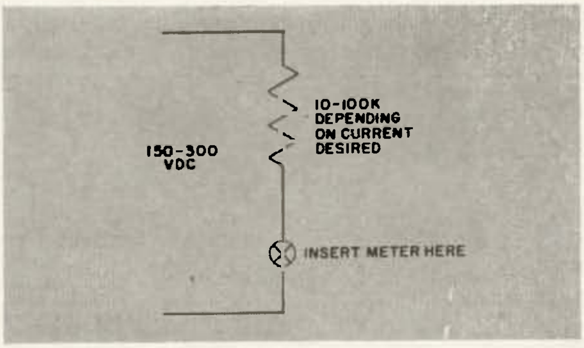
This procedure is actually the same as the average-calibration-error technique described earlier, and on the first run through will lump together both calibration and standard errors. To eliminate calibration errors, borrow a couple of meters from friends.

Measure each standard with each meter, and average out these readings before plotting the graph. After finding the corrected values of the standards, recalibrate all three meters. For a check on accuracy, locate another standard with a value different from any used in the procedure and measure it with each meter. Readings should agree, within the 3-percent-of-full-scale limit of accuracy.

AC

You may be saying at this point that all we've talked about has been dc voltage calibration, and you're right. The voltage scales of a meter are the ones most frequently miscalibrated, and dc calibrations are the easiest to break yourself in with.

In fact, for an accurate ac calibration you must have access to a scope. In addition, an accurately-calibrated dc meter can help out.



Fig' 5

The first step in an ac calibration is to temporarily calibrate the scope screen. This is done by using a pair of 105-volt VR tubes and a resistor together with the 117-volt ac line as shown in Fig. 4, and adjusting the scope vertical gain controls until the flat tops of the clipped sine waves are 21 horizontal divisions apart. At this adjustment, each horizontal division represents 5 volts (to 5 percent accuracy). You can check the calibration with a known dc source by connecting the dc source to the scope input and noting where the top of the resulting pulse hits the scope screen scale.

Next, hook up a stiff voltage divided across your ac supply and adjust it for a peak-to-

peak output of 141 volts, as measured using the calibrated scope. RMS voltage of the divider will be 100, to the same accuracy as the scope calibration. The divided output becomes your standard for meter calibration.

If your scope has an accurate voltage-divider COARSE vertical gain control, you can pick up additional calibration points at 10-volt and 1-volt RMS levels. Make the initial calibration with the COARSE gain at X100, and proceed as described above for the 100-volt calibration.

Then switch the COARSE gain to X10 without changing other scope settings, and adjust the voltage divider for the same indication on the screen. Divider output will be 10 volts RMS. Adjustment of the divider with COARSE gain in the X1 position gives an RMS output of 1 volt.

However, even with only one calibration point at 100 volts, your readings will be far more accurate than if you follow the normal kit-calibration procedure of assuming that line voltage is 117—when it regularly varies between 100 and 130 volts at most locations, depending on time of day!

Ohms

With both ac and dc voltage scales calibrated, all that's left for you to do is to make the current and resistance scales accurate. For not-so-obvious reasons, let's look at the resistance scales first.

By far the simplest, fastest, and least expensive way to calibrate an ohmmeter is to use 1-percent deposited-carbon resistors as your standards. These are available for less than $1 each in virtually all standard values; get one for each scale, picking the midscale value. Tape the standard resistors to your ohmmeter, and calibrate it before each use instead of zeroing it in the usual manner. This will give you more accurate readings over more of the scale.

Amps

Now, with both the voltage and the resistance scales calibrated, the current scales can easily be set to comparable accuracy. Set up a calibration jig as shown in Fig. 5, and measure the resistance of (with power off) and the voltage across (with power on) the resistor. Plug the figures into Ohm's Law to determine actual current through the circuit (accurate to the same degree as your earlier readings).

Then break the circuit at the point marked X and insert the meter, set to the proper current scale. The difference between the measured and the calculated current values is your meter's error.

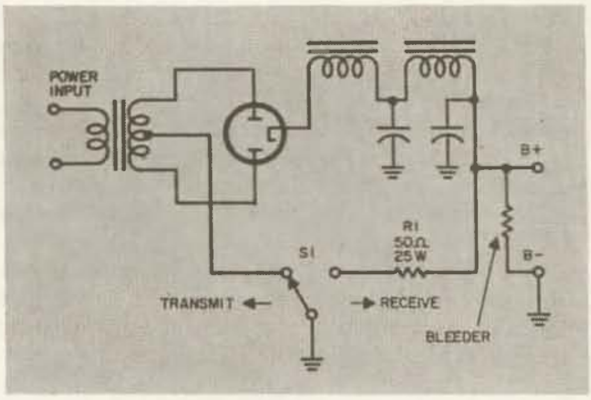
These adjustments take some time, and you may wonder if there's any way of speeding up the process. The answer, unfortunately, is no. As we said at the beginning, accuracy is expensive—and if you don't pay the price in cash, you must pay it in time. However, it's a worthwhile investment—for when you can put your readings into *accurate* numbers, then you can discuss them and work with them. If the readings are precisely inaccurate, they're worse than useless. . . . K5JKX/6

Does Your Rig Have "Hangover"?

My low-power home-brew rig had the annoying habit of blocking the receiver for several seconds each time the "TRANSIT-RECEIVE" switch was thrown to "RECEIVE." This was especially noticeable when the transmitter and receiver were tuned to the same frequency.

After exploring several possible causes of this phenomenon, the search narrowed down to the high-voltage power supply. The filter capacitors did not have sufficient time to discharge, and kept the transmitter "alive" for an agonizing eternity whenever I signed over to the OM at the other end of the QSO.

The bleeder resistor was checked, and found to be OK. Reducing the ohmic value of this component would discharge the capacitors faster, but the voltage would be pulled down, and the bleeder would waste power. The final solution was simple and effective. A single pole, double throw switch was substituted for the original SPST in the negative return of



the high voltage supply. Connected as shown in the diagram, the switch opens the B— return and shorts out the B+ when thrown to the "TRANSMIT" position. R1 is a 50 ohm, 25 watt resistor whose function is to protect the switch from burnout by limiting the discharge current. . . . W2WYM

Wayout Measurements

with close at hand equipment
or
you to can be a standard

Carl Henry
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Chattanooga 4, Tenn.

EVERY carpenter sharpens his tools before using them. Most electronics workers do not. Electronics is the only field I know of in which measurement equipment is considered separately. Perhaps this is because many of us view measurements and calibration as the special task of the instrument laboratory. Anyway, why bother? My VOM is pretty accurate. Or is it? Of all the measuring instruments, the D'Arsonval movement is the easiest to lose its accuracy due to shocks, magnetic fields and temperature. If ten hams or technicians compared voltage or current readings with their VOM's, there probably wouldn't be two alike. The service technician avoids this problem by allowing 50% tolerance on all his readings. In fact, most current commercial equipment allows this much variation in most circuits. But times are changing. Color TV, transistor radios, industrial applications of electronics, all require a greater accuracy of equipment. Modern equipment is using circuits whose margin for error is close to zero. This is a direct result of greater finesse in design, but knowing this doesn't help you troubleshoot equipment that apparently has every voltage and resistance wrong.

Okay, so you will agree with me. But you say, my junk box doesn't have any General Radio equipment in it. Well OM, clamp those cans tight; you are about to hear some methods of checking to 1% with equipment you have on hand, or can get for less than $1 . .

You will need at least one rf ammeter, 1 to 10 amps, 1 or 2 59¢ 1% resistors, and a standard cell. Ah ha, you say, that guy's been under a bench in an instrument lab too long!

But really, almost everyone has a poor man's standard cell around. A mercury cell, of course. All manufacturers state their mercury cells to be 1.345 volts, but all we need to know is that they are 1.35 volts within 1%. 1% is a very good place to stop in calibration work; any less will not be accurate enough, and any more will drive you crazy trying to maintain it. Calibration is really very simple, isn't it? Wipe that smile off your face, though, because you will have to know differential equations to understand the rest of this article.

Shook you up with that I bet! Oh well, go on to the next article on "how to transistorize your mother-in-law." But for the rest of you stalwart amateurs, I shall continue.

The first item we are interested in is the measurement of voltage. The mercury battery can be used to check up to 10 volts or so. For higher ranges, use a setup as in Fig. 1. The accuracy of the meter used for this is not important. The resistor's accuracy will determine the accuracy of the voltage.

The ac section of your VOM is harder to check. For this you must have an rf ammeter. About 1 amp is fine, but you can make do with a higher range. The purpose of this meter is to compare a dc volt, which we can now measure with some degree of precision, with an ac volt. We can do this since a thermocouple type meter depends on heating effect for its indication, and is good from dc to the frequency where skin effect begins. However, for best accuracy, reverse the meter and average the readings. Fig. 2 illustrates the comparison method of getting an accurate ac voltage from 6 to 600 volts. The rf ammeter will also allow you to compare dc to ac current, if your meter has such scales. . .

Now you have an accurate dc volt, dc resistance (59¢ precision resistors, remember?), and ac volt. Using Ohm's law you also have an accurate dc and ac amp, with one other item. The other needed item are several 1%, 20 or

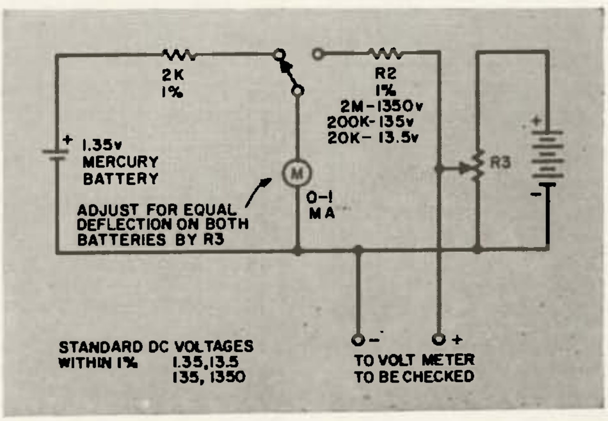


Fig. 1

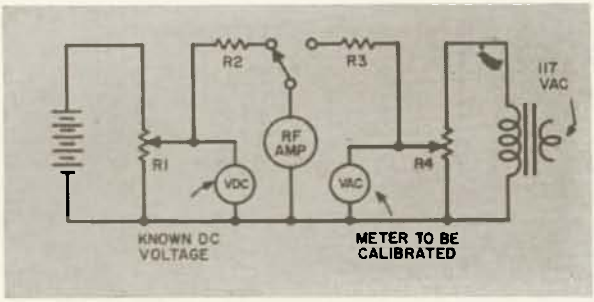


Fig. 2

30 watt resistors. You probably have many of these already. Due to the way they are made, power resistors are usually within 1% tolerance. They make very good precision resistors, and will allow you to check up to 10 amps with a known voltage, giving you of course a known current.

Now you have an accurate volt, ohm, and amp. What's left? Well, how about impedance? Also, from time to time you need to know capacitance, inductance, Q, and dissipation factor. To measure these items, we will call on more comparison circuits and an accurate ohmmeter.

Use the circuit of Fig. 3 to determine the total impedance of the component under test, at the desired frequency. You can check the component at several frequencies, and graph the results if you wish. The method is one of comparison, and the accuracy of the indication meter is not involved.

To determine inductance or capacitance, use the following method. First determine the impedance using the system shown in Fig. 3. Then, set up the circuit in Fig. 4. Using graph paper, set up the vector shown. To do this, draw out the measured voltage E2 on the X axis, to the right. Draw an arc from the center of the graph, having a radius or length E1, and draw an arc from the end of the E2 vector. At the intersection of these area, to the zero point, draw in E1. Draw in E3, and drop a perpendicular line from the E1-E3 point to the X axis. You can do this with a protractor. Now, if you have set up the graph in volts per division, you can read the voltage drop across the resistive component of the impedance directly from the graph. Voltage and resistance ratios are directly comparable, so you can determine the resistive part of the

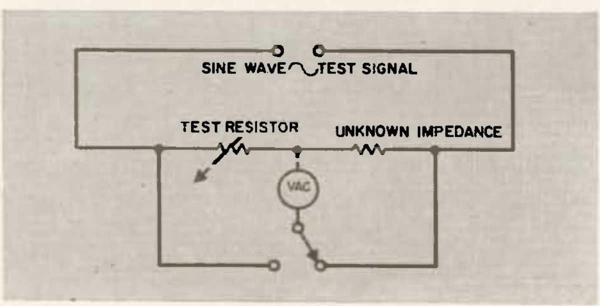


Fig. 3

impedance by $\frac{\text{Ezr R2}}{\text{E2}}$. Now you have the reactance by the following relationship: X equal $\sqrt{\text{Z2—R2}}$. Remember to graph inductive reactance upward, and capacitive reactance downward. The capacity or inductance can be calculated directly from the reactance value. Remember too that nothing holds still in electronics, so check at several frequencies if you want a more accurate result. The Q of a coil can be found without further measurements. Use this formula: Q equal $\frac{\text{Zx}}{\text{Zr}}$ or $\frac{\text{XL}}{\text{R}}$. The dissipation factor of a capacitor is a reciprocal relationship, or: D equal $\frac{\text{Zr}}{\text{Zx}}$ or $\frac{\text{R}}{\text{Xc}}$.

I don't expect there to be any drop in the sales of impedance bridges when this method is published, but it does demonstrate that many types of accurate measurements can be made with simple equipment.

From time to time you may have occasion to measure the output impedance of an amplifier or oscillator. This can be done with a simple method. First measure the output voltage with an open circuit. Then add a variable resistance across the output, and vary it until the output drops to half its open circuit value. Dis-

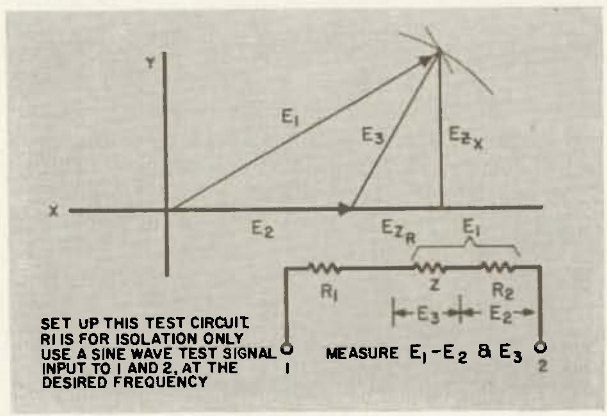


Fig. 4

connect the resistance and measure it. This is the complex output impedance at whatever particular frequency you are using. Be especially careful of distributed capacitance in test leads at the higher frequencies. Keep all circuit connections short. Microphone impedances can be determined in a similar fashion, but due to low level from the mike, you will want to use an amplifier between the mike and resistance, and the indicator.

To determine the input impedance of an amplifier you use the same method on the input. Leave the indicator (voltmeter or 'scope) on the output, and connect a variable resistor in series with the input. With some source of a signal such as an audio oscillator on the input, adjust the input voltage for some convenient output, but don't overload the amplifier. Now increase the value of the variable resistor, which has been set at zero, until the output

drops to half its value. The complex input impedance is equal to the value of the variable resistor. This impedance is a combination of series and parallel capacitance, inductance, and resistance. You can see that the term complex means exactly that!

Loudspeaker impedances can be determined using this method. Try a speaker at several different frequencies in the audio range. You'll be surprised at what you find.

Transformer ratios can be determined by checking the input impedance with the output winding loading determined by a known fixed resistor.

In all these measurement methods, remember to use sine waveforms, if at all possible. Most ac voltmeters will read incorrectly in the presence of harmonics. Keep test circuit capacitance and inductance to a minimum by using short (relative to frequency) test leads.

The above discussion will serve to demonstrate to you that accurate measurements can be made using very simple tools. Or, "most progress concerns sharper tools and simpler methods."

References: ELECTRONIC MEASUREMENTS—Terman and Petit.
RADIO ENGINEERING HANDBOOK—Henney

On Soldering

David Heller K3HNP

MUCH is available in the handbooks, construction guides and in the minds of communications people everywhere on how to solder. There's probably no question that every amateur must make frequent soldered connections even if he never built a thing in his life, and it's unfortunate that much soldering is improperly done — either with improper solder, the wrong flux, the wrong iron — or with improper technique. But technique is seldom the cause of failure. Most hams are pretty good with the soldering iron. Because they've been using the wrong equipment so often they'd have to be good to have their equipment work at all.

About the solder itself: it is a mixture (alloy) of tin and lead—as you know—and comes in various grades, such as 40-60, 50-50, 60-40, etc. The first number is *always* the proportion of tin. The difference between grades is the melting point, strength and cost.

Melting points of various combinations are:

40-60	460°F
50-50	425°
60-40	371°
63-37	361°

But the solidification temperature is 361° for all. The in-between range (such as 361° to 425° for 50-50) is the plastic range, in which the solder has no strength, and is mushy. If a joint is moved even slightly while cooling through this plastic range the all-too-familiar "cold-solder" joint inevitably results. Please note now that the 63-37 mix has no plastic range. Is this a solder that won't produce cold joints? Strangely enough, it is! It's possible to make a bad joint with 63-37 (Eutectic) solder, but not if any attempt is made not to. As the mix gets lower in tin content the plastic range expands, making good soldering more and more difficult.

I like to solder with the least possible heat, for I'm somewhat annoyed to see the wax flow out of little condensers and the insulation melt off wires. It seems as though the diode and transistor people warn about too much heat, also. So why not choose 63-37? It does melt at a lower temperature than any other solder.

Is there any difference in strength between grades? Not enough to talk about. How about cost? Today lead sells for 13 cents a pound, and tin, $1.04 per pound. So the tin content determines the price, and 63-37 should cost about 1½ times as much as 40-60. It does.

So it would seem from above that 63-37 solder is the best for radio construction. It is. Get a small piece from one of your engineer friends and try it. Second best is 60-40, which has a big advantage—it's much more easily available. If you are now using a lower grade 60-40 will seem so much better that you'll probably be satisfied. But 63-37 is even easier to use—and costs only about 5 cents a pound more. Bother your dealer until he stocks what you want.

About flux: this is a bigger unknown than anything else in soldering. In my work I've accumulated several hundred different flux samples; seldom do the claims correspond with results. The important thing to remember is: Use a rosin radio flux only. Never use a chloride "acid core" flux or the "non-corrosive" paste fluxes on electronic equipment; they're as non-corrosive as hydrochloric acid and a lot harder to get rid of. Don't even use your radio soldering iron with acid core or paste fluxes—the stuff won't evaporate away, and the corrosive materials will end up just where you don't want them. The only way to remove these chloride fluxes is by scrubbing with hot soapy water! Follow the warning in kit instruction manuals: don't use acid or paste fluxes.

Even in rosin cores there are many different compositions. Those of the reputable manufacturers are properly compounded and both safe and effective; bargains can give much trouble. Satisfactory fluxes include National Lead (Dutch Boy) Hyax, Kester '44', and others. Some have rather interesting claims based on special shapes of the flux cores: multiple cores, stars, etc. These have no demonstrated value at all.

There are many special fluxes for aluminum, corroded brass, steel, etc. which can be used in electronic equipment under controlled conditions. These are best neglected—the uses are specialized and the fluxes are not generally available.

The choice of soldering irons seems usually to be made on the basis of convenience—not by what the job requires. The soldering iron needs only get sufficient heat to the work to get the joint (not just the solder) to the solder's melting point. Most of the small "pencil irons" won't do this on larger joints. The proper tool for most soldering is a 100 watt iron with a ⅜ inch plug tip. The pencil iron is often good for fine wires in tight places, but the big one will do a better job faster most everywhere.

The quick-heating gun is a common tool these days; this is a poor choice for construction, though acceptable where only one or two rapid connections need be made. The proper heat is almost impossible to maintain, and heat transfer is poor. Too small an iron will often overheat parts simply because it must be kept on a joint too long.

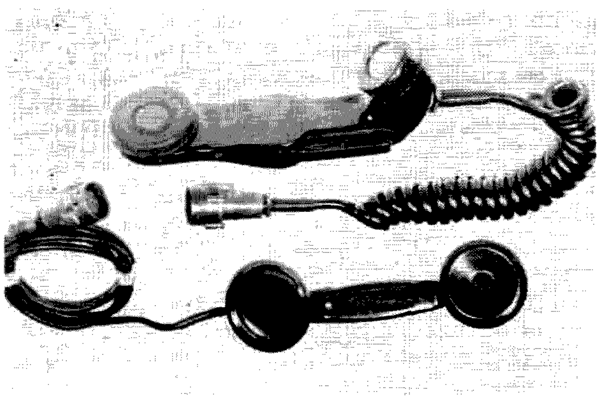
Chassis soldering requires a 200 or 300 watt iron. If one isn't available, better use screws. But a big iron is nice to have for soldering antenna connections on windy days. A big iron is a good tool to have in the shack—the uses are more frequent than might first be thought.

No—nothing here about how to solder once you have the proper solder, flux and iron. That's all covered in the various handbooks, and especially in the construction manuals of Heath, Eico and other kit manufacturers.

Surplus Audio Accessories

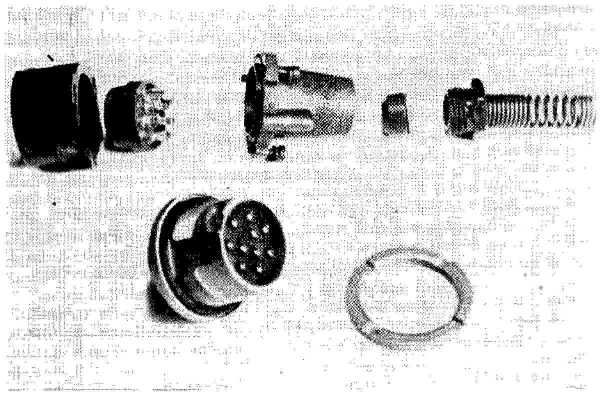
Lately released surplus handsets, microphones and speakers are fitted with a new type, 10 contact quick connect-disconnect audio connector. The accessory plug is the Amphenol number 164-28 (Military U-77/U) and the Amphenol 164-7J (Military U-79/U) is the mating chassis receptacle. The schematic shows the connections of the H-33/PT handset which is representative of the types available. Termination is standardized, although some handsets have only a single section switch.

Before you reach for the cutters to snip off the new fangled termination and substitute the old familiar PL-55 and PL-68, THINK. These connectors are rugged enough to withstand the roughest field conditions and, at the same time, attractive enuogh to grace the panel of the most sophisticated equipment. The receptacle mounts in a single 1" round hole with lock nut. The photograph shows the simple assembly details of the plug and receptacle. To cinch the argument, Olson Electronics, 260 S. Forge Street, Akron 8, Ohio, lists the U-79/U chassis receptacle on page 21 of their spring catalog at 19¢ each or six for a dollar.

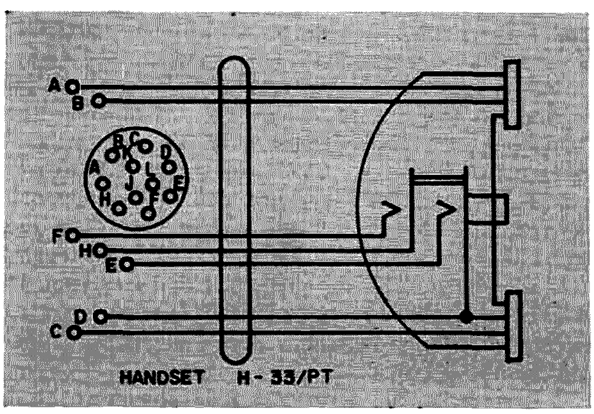


Handset, H-33/PT (Top) is the most common field radio handset. Handset, H-90/U (Bottom) is a conventional communications handset, fitted with the new connector.

The accessories reaching the market today are only a trickle of what will come and the new connector is the standard. The photograph shows two of the currently available handsets. One is the new configuration and one the old. Both are fitted with the new style connector. Get in line . . . you can't afford not to. . . . Pafenberg



The U-79/U female chassis receptacle (Top) and the U-77/U male plug (Bottom), shown in the exploded view, are the most popular of the new audio connectors.



Schematic diagram of Handset, H-33/PT. The wiring of many other handset types is identical.

Two Meter Transceiver

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Brooklyn, N. Y.

If you have been listening on the VHF bands lately, you must have noticed that almost everybody is using a transceiver of one type or another. Almost all of these transceivers are commercial. Most amateurs sound horrified if you suggest building, instead of buying, a transceiver. The typical arguments are that it is cheaper to buy than to build, the parts are very expensive, they never work right, commercial units are easier to use, home-brew units do not have the appearance of commercial gear, or, some other ridiculous statement. It is not cheaper to buy than to build, even if you buy all the parts new. Parts are not expensive and the majority of them can be gotten out of the junk box. If any care is taken in the construction of home-brew equipment it will work just as well, if not better, than commercial equipment. With a little planning, home-brew equipment can be easier to use than commercial equipment. As far as appearance, most commercial equipment does look better than home-brew, but I have seen home-brew equipment that will compare with commercial gear.

I wanted a two meter transceiver for the mobile that would have reasonably low power requirements because I use the rig a good part of the time with the motor off. The object of the project was to build a good mobile rig at the lowest possible cost.

A careful look through my junk box disclosed that most of the necessary parts would not have to be purchased. An old television set can provide approximately 75% of the parts needed. The remaining parts can be obtained from a defunct FM tuner, the junk box, or by purchasing them. Most values of resistors are not very critical, and one close enough to the necessary value can be found in almost any television set. The same applies to condensers except where one is being used in a resonant circuit. Tubular condensers are not very good for rf by-passing. For rf by-passing ceramic discs are recommended, and are necessary above 50 mc. It is permissible, however, to substitute values slightly different than the specified value. For example a .002, .005 or some other similar value can usually be substituted for a .001, although a .001 is recommended above 100 mc. At two meters, the

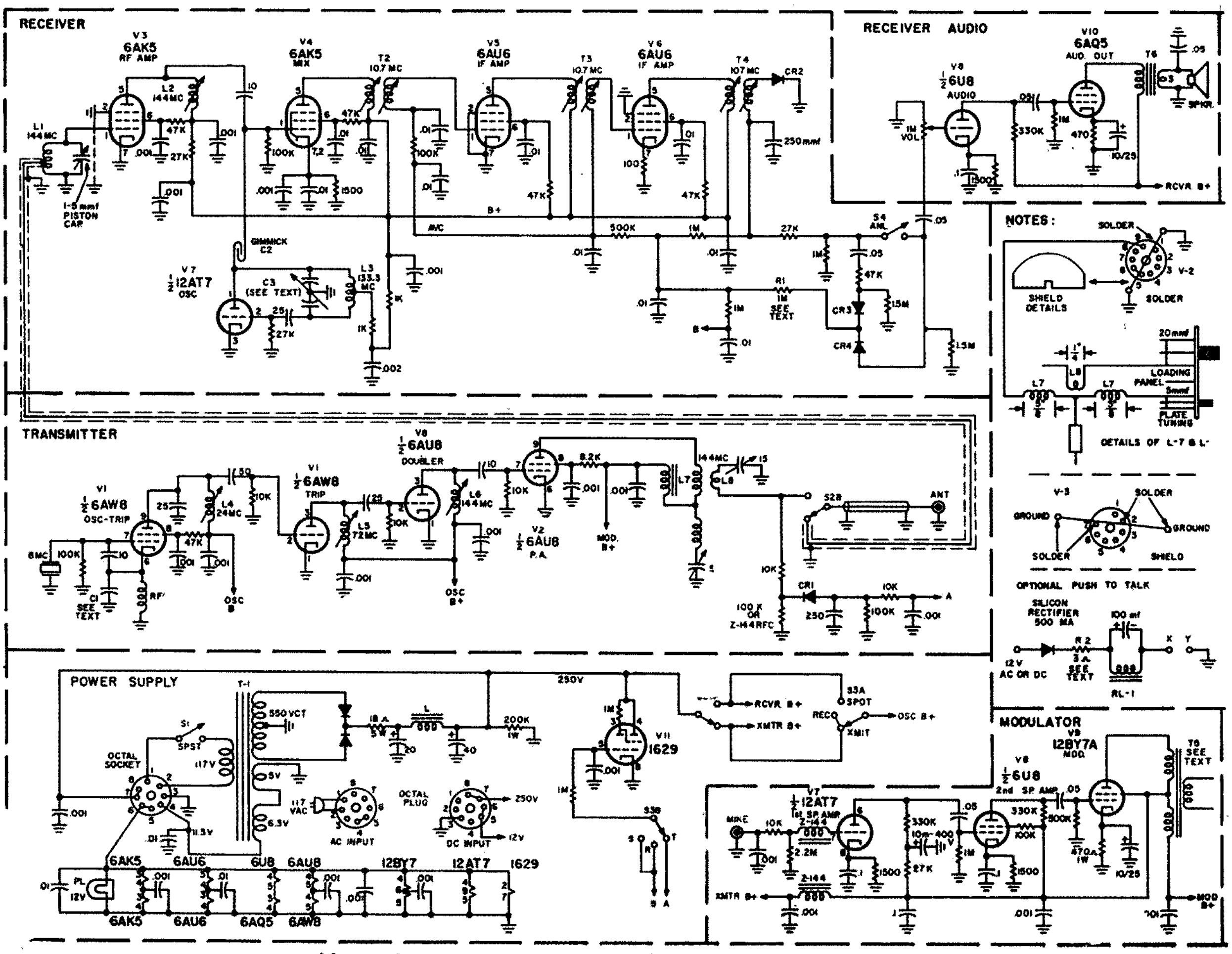
inductance of the leads becomes important, and the condensers should have the smallest possible physical size.

The chassis is an open end type with aluminum plates on each end to form the front and back panels. The chassis is not used in the conventional manner because the wiring is on what normally is the top to make the construction easier. The size is not critical, but it should be big enough to fit everything on it without excessive crowding. The chassis used for my transceiver was 8" x 10" x 2" with the end plates being 8" x 4½". This size was chosen only because the chassis was in my junkbox.

The power supply used in the mobile is external to prevent vibrator hash. It is the power supply from an old auto radio, but any supply delivering about 250-300 v at approximately 50-75 mils can be used. The heaters are wired for 12 volt operation but they can be wired in parallel if the rig is going to be used on 6 volts. An ac supply was included in the unit because it increases the usefulness of the transceiver. The power transformer was taken from an old fm tuner. Since the transformer did not have a 12 volt winding, the 5 volt and the 6.3 volt winding were connected in series and phased to give 11.3 volts. Although this is slightly lower than the tubes are supposed to have, the rig works fine at this voltage. If the transceiver is to be wired for use on 6 volts, only the 6 volt winding is used.

Any power transformer giving between 250 and 300 volts will work fine. The rectifiers used were 800 volts piv. silicons, although a 6x4 or 12x4 will work. Filter choke "L" can be any small choke. If one is not available, a 200 ohm 10 watt resistor can be substituted, but this will result in slightly reduced plate voltage. S2 is a DPDT rotary switch and should have a low loss type of insulation as it is also used for switching the antenna. The tuning indicator is a 1629 tube which is available on the surplus market for about 25¢. For 6 volt operation, a 6U5 or similar tube can be used. These tubes have different bases and pin connections than the 1629.

The transmitter section uses two tubes and is quite simple to build. It uses 8 mc rocks and the final runs straight through. The approximate power input is 5 or 6 watts, which is sufficient for local work. When conditions are right, quite a large distance can be covered with this power. One-half of a 6AW8 is used as the osc.-tripler. "RFC" can be a 2½ mh rfc with "C1" being about 150 mmfd. A smaller rf choke like the ones used in the 21 mc *if* strips of old TV sets can be used by changing the value of C1 to approximately 35-50 mmfd. The plate coil is a slug-tuned coil tuned to 24 mc. Slug-tuned coils were used throughout the multipliers and once tuned up around the center of the band are broad enough to work over the entire band without readjustment. To help prevent oscillation in the final, a shield is placed across the socket of V2 to prevent coupling between L6 and L7. C4 is run through a small hole drilled in the shield, not over or around the shield. The shield is made from the top of a beer can. The top is cut in half and soldered across the socket. No trouble was experienced with oscillation in the final, but the final was neutralized anyway. For those who are interested in neutralizing the final, a 1" neutralization stub was soldered on the grid pin of the final. Plate and screen voltage was removed from the final and grid drive was applied. The position of the stub was adjusted for minimum feed-through, using a GDO as an indicator. No trouble should be encountered in getting the transmitter to operate properly if all the leads are kept as short as possible and grid leads are kept away from plate leads. The layout is not very critical although keeping the stages in a straight line is recommended. There is more than enough drive to operate the final properly if everything is working and all the multipliers are tuned properly. A 6AW8 can be substituted for V2 but a 6AU8 doesn't seem to give enough drive as V1. Substituting a 6CX8 for V2 is not practical for 12 volt operation because of the difference in heater currents. I tried one just to see how much dif-

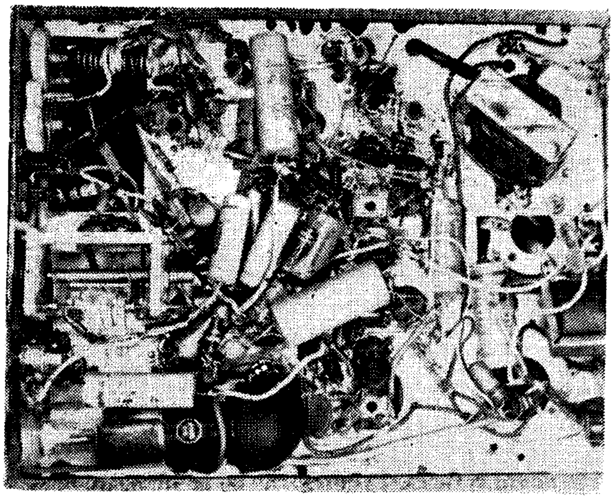


Note: L7 mounts to pin 9 of socket with NO lead.

ference there was, using a 955 as a heater ballast in parallel with V1 to make up the difference of 150 mils in the heater current. The efficiency of a 6CX8 on 2 meters proved to be much poorer than a 6AU8 or 6AW8, so that idea was quickly discarded. To use a vfo with the transceiver, short the cathode of the osc. tube to ground. The 8 mc output of the vfo is fed into the xtal socket. The stage acts as a tripler.

The final amplifier is high level plate and screen modulated by a 12BY7A. Since I did not have a suitable modulation transformer in the junkbox and I did not like the idea of going out to buy one at the current prices, I used a vertical blocking oscillator transformer from an old TV. It works fine and I have gotten excellent reports on the quality and percentage of the modulation. The unit used had a 1:1:1 ratio with impedence being unknown. It was connected as a 1:1 auto transformer leaving the other winding disconnected. The speech amplifier is ½ of a 12AT7 followed by the pentode half of a 6U8. For anybody who is curious as to why I did not use the triode half of the 6U8 as the other speech amp, the reason is that one half of the 12AT7 is being used as the local oscillator of the receiver and using the other half as the receiver audio might affect the stability. A Z-144 is used to keep rf out of the modulator, as any rf getting into the modulator can cause some awful feed-back. A 10 mfd electrolytic and a 27K resistor are used to decouple the first speech amp and prevent any tendency toward motor-boating. The modulator has more than sufficient gain for even low output crystal microphones.

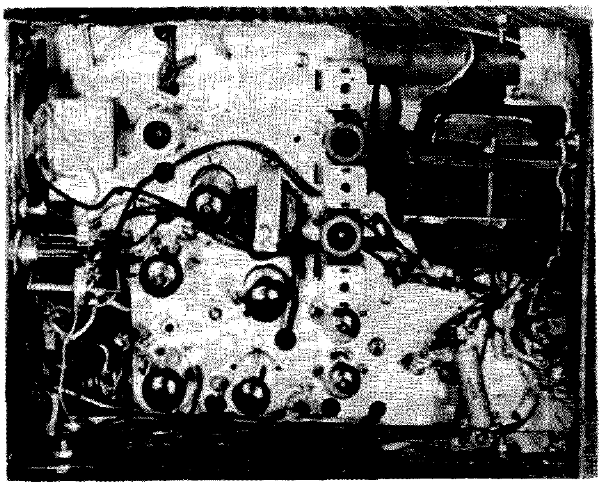
The receiver section is a single conversion superhet and although it is not very complicated it works quite well. 10.7 mc *if* transformers were used because they were available from an old FM tuner. The image frequency is far enough away to keep the level of the images low enough so they are not noticeable without using any kind of bandpass circuitry. The layout should be in a straight line for the best and most stable performance. The first rf amplifier has a shield across the socket to prevent oscillation caused by coupling between L1 and L2. L1 is a air-wound coil tuned by a small piston capacitor. A slug-tuned coil could be used but I felt that a higher Q coil would help image rejection. The tap on L1 is adjusted for maximum signal to noise ratio. It will be approximately ¼ of the coil from the ground end. L2 is a slug-tuned coil tuned to 144 mc. The coil forms should have a slug as designed to operate at this frequency. (The same goes for the multiplier coils in the transmitter.) The coil forms used came out of the tuner of a television set and were used for tuning the higher channels. Care should be taken to prevent any coupling between the input and output of the rf amplified by leads running near both coils that could couple rf between them,



as this stage will oscillate quite easily. The oscillator is tuned 10.7 mc lower than the received signal. The oscillator tuning condenser, C3, is a dual condenser of about 5 mmfd per section. One like this was not available so it was made by ripping plates off a condenser with more capacity leaving one rotor and one stator plate in each section. To get a more favorable tuning ratio a small ceramic trimmer of about 1-5 mmfd can be placed across the entire winding of L3, and by playing around with the inductance of L3 and the trimmer, almost any tuning range of C3 can be achieved (within reason). C2 is made up of two one inch pieces of insulated wire hooked around each other. The way the unit was laid out, V7 was nowhere near the mixer so a 20 mmfd capacitor was connected from the plate of V7 to a 6 inch piece of RG58/u and C2 connected to the other end of the coax. The *if* amplifiers are not very much trouble to wire, the only precaution necessary is to keep the grid leads away from the plate leads. CR4 and CR3 are used as a full wave series noise limiter. The value of R1 should be adjusted to limit at 100% modulation, the value depending on the diodes used. CR2, CR3, and CR4 should all be of a type that has a fairly high back resistance and low forward resistance.

Push-to-Talk

Push-to-talk was not included in the rig. If anyone would like to include it in the rig, the only additional parts required are a 500 ma. silicon rectifier, a 12 vdc dpdt relay, a 100 mfd 25v miniature electrolytic condenser, and a 3 or 4 ohm resistor. The use of a dc relay permits usage in the mobile. The rectifier changes ac to dc when the rig is used on ac and has no effect when the rig is used in the mobile. The electrolytic eliminates relay chatter. The ptt switch is connected between X and Y. The relay replaces S2. R2 can be omitted but it protects the silicon rectifier from damage due to surge currents. This ptt system is in use in another rig and it works fine. For 6v use, a 6v relay could be substituted and will probably



work as well, although the voltage drop across the rectifier may cause problems with some relays. The way the rig is wired, only one pole of the relay is needed to switch from transmit to receive, the other pole switching the antenna.

Smoke Test

After the wiring is complete and carefully checked for errors, shorts, and similar things, the next step is usually to give it the smoke test. This consists of turning it on and watching for any smoke, as from burning resistors, etc. If there is none, and everything looks normal, you can try tuning up the transmitter. Using a grid dip meter in the diode position, tune L4 for maximum output, using a crystal near the center of the band. Do the same for L5 and L6. If everything is operating correctly it should be possible to load the final to full output. For testing, a dummy load made from a number 47 pilot will work. Assuming the transmitter is now working, plug a mike in and test the modulator. If you are using a pilot for a dummy load, it should get considerably brighter when you speak into the microphone.

To align the receiver disable the oscillator by pulling out V7. Using a signal generator, apply a signal at the grid of V6 and tune T4 for maximum. Then work back to V4 using the same procedure. Now plug in V7 and make sure the oscillator is tuning the proper frequency. Using a 2 meter signal or the spot position on the transceiver tune L1 and L2 to maximum output. The tuning indicator, V11, can be used as an indicator for alignment. Next, using a weak on the air signal, adjust the tap on L1 for the best signal to noise ratio.

The transceiver should now be ready for on the air tests. Before putting the transmitter on the air make sure that there are no parasitics and that all the coils are tuned to the correct frequency. To use the transceiver the only tune-up necessary will be the final tank circuit, all the other coils being broadband enough not to require retuning. Tune the transmitter for maximum indication on V11. V11 will also be a tuning indicator for the receiver. The case was made from a piece of perferated steel which can be purchased very reasonably in most hardware stores. Putting the case on slightly detunes L3 but this was quite easy to correct, as the difference is only a few hundred kc.

I have gotten excellent results with this transceiver, and it seems to compare favorably with commercial equipment. The total outlay for my unit was approximately $5.00, with the rest of the parts coming from the junkbox. Even if most of the parts are purchased, with a little shopping around it should be possible to build this transceiver for approximately $30 to $35. At this price, it is almost impossible to get anywhere near the performance per dollar by buying a rig. It works wonderfully in the mobile, and the receiver doesn't drift noticeably with changes in operating voltage that are typical of mobile operation. The appearance is greatly improved by spraying the panels and the use of decals.

The unit described here has given me many enjoyable hours of operating, both at home and in the mobile. . . . WA2INM

Coil Table

L1—5t #20 wire ⅜" dia. spaced approximately ½" tapped at 1½t. from grounded end.
L2—4t #20 wire on ¼" slug tuned form spaced ½".
L3—3t #20 wire ¾" dia. spaced approximately ¾", ct.
L4—15 turns #20 enameled wire on ¼" slug tuned form.
L5—5 turns #20 enameled on ¼" slug tuned form spaced ¾".
L6—4 turns #20 wire on ¼" slug tuned form spaced ¾".
L7—10 turns, ct #20 wire ½" dia. wound 5 turns, ¼" space and 5 more turns, the overall length being approximately 1½".
L8—3 turns insulated wire in the ¼" space in the center of L7.
Note: The coils as given should resonate at the correct frequency. If one of them fails to do so, this can be corrected by either spreading or squeezing the turns, depending on whether the coil is lower or higher in frequency.

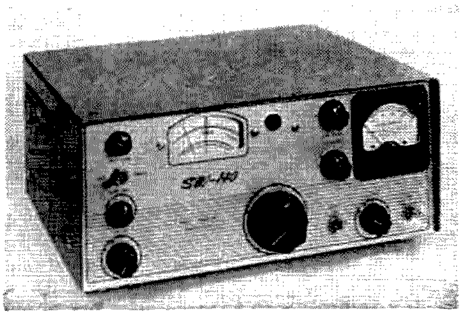
Errata

A couple of clarifications of the diagram are in order: The plate choke is an Ohmite Z-144. The B-plus for the V8 doubler should connect to the "xmtr B-plus" to give less signal on "spot."

Soldering Tips

Emergency tips for the Weller and similar type soldering guns can be made from a piece of #12 copper wire (solid). To make a tip, just bend the wire to the approximate shape of the original soldering tip and squeeze the center ½ inch together to form a heat sink with which the soldering is done. WA21NM

Swan Engineering Co.
SSB Transceiver



SW-175 3.5-4MC, SW-140 7.2-3 MC
SW-120 14.2-14.35 MC

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If it's receiver per dollar you want
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130 watts PEP input to 6DQ5 Power Amplifier.
High frequency crystal lattice filter; 3 Kc. nominal bandwidth, used for both transmit and receive.
Unwanted sideband down approximately 40 db. Carrier suppression approximately 50 db.
Transmits automatically on receiving frequency.
Exceptional mechanical, electrical and thermal stability. Frequency is practically unaffected by voltage or temperature variations, or by vibration when driving over rough roads.
Receiver sensitivity better than 1 microvolt at 50 ohm input.
Smooth audio response from 300 to 3,000 cycles provides excellent voice quality for both transmitting and receiving.
Control system designed for greatest ease of mobile operation. Front panel controls include: Main Tuning, Volume, Carrier Balance, Microphone Gain, Exciter Tune, P. A. Tune, P. A. Load, T-R Switch, Supply On-Off Switch, and Tune Switch.
Main Tuning control *is* firm and *smooth*, with 16:1 tuning ratio. Calibrated in 2 Kc. increments.
Transceiver produces approximately 25 watts carrier output on AM by simply adjusting the Carrier Balance control. Receives AM signals very satisfactorily.
3-Circuit microphone jack provides for Push-to-Talk operation.

POWER SUPPLY REQUIREMENTS:

275 volts DC, nominal, at 90 ma., receive and transmit.
650 volts DC, nominal, at 25-200 ma., transmit only.
80 volts DC, negative bias, at 6 ma., receive and transmit.
12.6 volts AC or DC at 3.45 amperes, for filaments.
Heath HP-10—HP-20.

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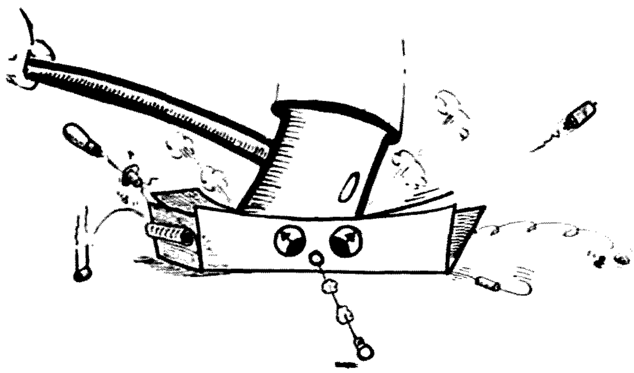

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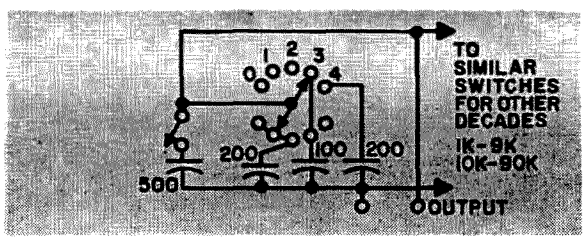
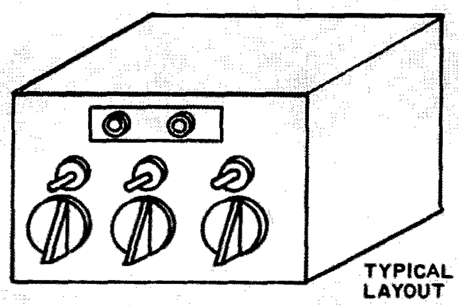


By a simple circuit trick we can build a box which will give us 1000 different values at a fraction of the cost of a commercial three decade box. Practically the whole story can be gleaned from an examination of the circuit diagram, or you can read on to learn how it came about. The three decade box uses twenty-seven capacitors to build up the 1000 different values. But if we take a tip from the Chinese Abacus we see they count to 1000 with 15 beads instead of 27. We can do the same with 15 capacitors instead of 27 by using 4 units of one and 1 unit of five to give each decade. We count up to 4 by ones, take off the ones and add a 5 and then add the



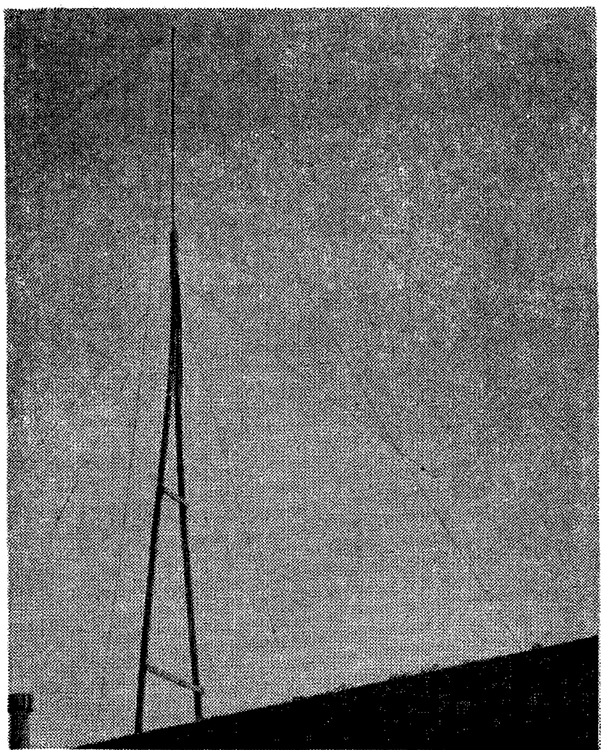
Capt. John Ellison W6AOI
1720 Holly Avenue
Menlo Park, California

ones to get to nine. Then we take off all nine and move over to 1 on the next decade, and so on. We arrange the ones on rotary switches and put the fives on each of three toggle switches, simple.

Next we find that there is no way to parallel condensers without using either a progressive shorting switch *or* using a two pole switch. Considering the second alternative we make a pleasant discovery, we don't need 15 capacitors, we can do it with 12 and still get the 1000 different values. Now in each decade we have a 1, two 2's and a 5 and the switch will do the combining to give us the unit count from one to four. This is shown in the circuit.

If we want to be real sneaky about it, and spend some time with an oscillator, a calibrated Broadcast receiver and a junk box of random values of capacitors we can end up with a three decade box of better than one-half percent accuracy by buying (or calibrating on an accurate bridge) three capacitors of one percent accuracy in the "two" value for each decade and building up the other values by comparison. Actually, it took me four hours from a cold start to check a box of capacitors to get suitable values, and assemble the whole thing in a 3" x 4" x 5" box. I chose to make mine to cover the range from 100 mmfd to .1 mmfd as the most useful ranges.

With twelve inch leads and all decades at zero setting, the residual capacity is approximately 26 mmfd. Cutting in each decade adds about 5 mmfd as stray capacity. Mallory makes a small inexpensive rotary switch in 2 pole 6 position size which is ideal for compactness. You should use an insulated strip for the terminals so that the box can be hooked into a hot circuit. I found three new uses for it in a week. . . . W6AOI



Antenna

Simple, inexpensive,

small, quick,

works!

Jim Kyle K5JKX/6
1851 Stanford Avenue
Santa Susana, California

ANTENNAS are important! From the lowliest Novice struggling to make the window-screen take a load, to the most advanced old-timer with a farm full of rhombics, we all know that fact.

This article does *not* describe a perfect antenna; it *does* describe an inexpensive antenna which requires exceptionally small space, makes an equally small dent in the pocketbook, and can be put together in approximately one hour.

The actual cost of the antenna, aside from guying materials and feedline, is less than $5 even on the slightly-expensive California coast. Add another $10 for coax and the ultimate in guying, and the cost is still less than half that of any comparable commercial antenna. Best of all, though, is its performance; while it's not intended to substitute for a beam, this antenna will outperform most omnidirectional types, due to near-perfect impedance matching.

Although it's not too evident from the photo, the basic ancestry of this antenna is the old familiar ground-plane. This writer fell in love with the ground-plane for any band above 20 meters while working with W5ZUS on a 10-meter version which—in his not-too-good location—outperformed the 3-element beam it replaced.

The apparent complexity of the photo is due entirely to mechanical considerations; electrically, the unusual thing about this ground-plane is the matching system. While stub-matched ground planes have been around for some time (the ARRL handbook provides complete design information for them, and has for a number of years), few hams have done anything with them so far as the literature shows.

Briefly, the electrical design philosophy is this: An ordinary ground-plane antenna has a feedpoint impedance between 25 and 30 ohms; when fed with coax, the usual case, this produces a mismatch giving standing waves as high as 3 to 1. In this day of pi-network output circuits, an SWR higher than 2 to 1 is likely to damage your transmitter; and at any rate, good engineering practice dictates that the SWR be kept as low as is practical.

By shortening the vertical element of the ground-plane, the radiation resistance can be raised to any desired amount. However, the short antenna is no longer resonant, and as a result reflects a capacitive impedance back to the feedline. This situation is even worse.

However, the capacitive reactance can be tuned out by an inductive stub at the feedpoint, so that the feedline sees only a 52- or 75-ohm resistance; SWR goes to perfection and the signal strength goes up.

The design equations to determine just how much to shorten the antenna, how long to make the radials, and how to build the inductive stub, are rather complex and are intimately connected with the mechanical design of the antenna as well. They have been worked out (for this mechanical design only) for coverage of the 20, 15, 10, and 6 meter bands and are listed in Table 1. However, it must be emphasized that the diameter of the vertical element and the size of wire used in the radials are key points in the design procedure, and if either is changed, the values in Table 1 may not apply.

At this point, let's look at the complex-appearing mechanical structure of this antenna. It's not pretty, but it's inexpensive.

The heart of the structure is the A-frame made of two 14-foot chunks of 1 x 2 lumber; its total cost was 85¢ for the lumber plus another half-buck for the nuts and bolts which hold it together. When the entire antenna is mounted atop a one-story residence, this frame lifts the active part of the antenna more than 26 feet in the air; this height is enough to minimize ground effects on all bands except 20.

The vertical element itself is made from 1¼-inch TV mastings; total cost was $1.69 for a 10-foot length (the 15- and 20-meter models require two lengths). One end was flattened for a distance of 20 inches, with the aid of a sturdy vise, and was then clamped between the 1 x 2's of the A-frame. The entire sandwich was then drilled for ¼-inch by 2½-inch aircraft bolts, which were pulled up firmly but not so tight as to split the wood. The other end of the masting, after being cut to length as shown in Table 1, was drilled through twice (at right angles to each other) with a ¼-inch drill to provide anchoring spots for the upper guys.

The next step in construction of the antenna is installation of the lower guys which double as radials. Two holes, each ⅛ inch in diameter, were drilled through the A-frame at a point about ½ inch below the bottom of the vertical element. A length of No. 14 stranded copper wire about 18 inches longer than *twice* the radial length given in Table 1 is then passed through each of the two holes.

To connect the four resulting radials together, a 10-inch length of the same wire is passed around the perimeter of the A-frame, and is wrapped once around each radial where it emerges from the ⅛-inch hole. The two ends of the 10-inch wire are twisted tightly to-

FREQUENCY IN MC.	USING 52 OHM FEEDLINE H	S	USING 75 OHM FEEDLINE H	S	R
14.2	15' 5"	6' 11½"	13' 11"	5' 8"	16' 11½"
21.3	10' 2"	4' 6"	9' 1"	3' 8"	11' 3½"
29.0	7' 4½"	3' 3"	6' 6½"	2' 8"	8' 3½"
50.5	4' 2"	1' 10"	3' 7½"	1' 5½"	4' 9"
52.0	4' ½"	1' 9"	3' 5½"	1' 5"	4' 7½"

H- Height of vertical element, made of 1¼" tube.
R- Length of radials, made of #14 copper wire.
S- Length of stub, made of RG8/U (regardless of feedline imp.)

Table I. Antenna dimensions.

gether, and all connections are soldered.

The other end of each radial is terminated in an egg-type strain insulator; length of each radial is adjusted to the value given in Table 1 at this time. These lengths are to be measured from the center of the vertical element to the bend in the radial where it passes through the strain insulator.

Now, the feedline and matching stub can be connected. Prepare the stub by cutting a length of RG/8-U to the length shown in Table 1, and carefully shorting the shield to the center conductor at one end. At the other end, separate the shield braid for about an inch and remove enough of the inner dielectric to allow a firm connection to be made to the center conductor. Prepare the feedline end in the same manner. Connect both center conductors to the vertical element—a No. 6 sheet-metal screw and a pair of solder lugs come in handy here—and both shield braids to the radials. Attach the stub securely to one leg of the A-frame, and the feedline to the other leg.

You're almost ready to hoist the structure aloft; the only steps remaining are the spreading of the lower ends of the A-frame, and provision for guying.

The lower ends of the A-frame should be held about 30 inches apart by a short chunk of 1 x 2 tacked lightly to the A-frame stringers. The final spreading will be secured by the mechanical connections between the base of the A-frame and the roof.

For guying, you have a choice of several types of material. This writer recommends using Glasline, despite its apparent expense. The upper guys, especially, must be non-conducting. This rules out any metallic guys, leaving only Glasline, plastic clothesline rope, and nylon cable. Both the clothesline rope and the nylon cable have unhappy tendencies to stretch under the influence of weather, and this stretch can be enough to dump your antenna to the ground some fine night.

The extensions of the radials aren't so critical, and metallic guys can be used here if expense is critical. However, it's simpler to use just one type of material, and the difference in cost isn't that great in most cases.

The upper guys are connected to the vertical element by lining the ¼-inch holes in the metal with rubber grommets, feeding the Glasline through the grommets until you have enough on each side to reach to the base of the A-frame and halfway back up the structure, then tying a loop knot in the Glasline *inside* the tubing (pull some slack out, tie the knot, feed it back). The knot won't go through the ¼-inch hole in either direction, thus giving you a firm connection at the top with no danger of a joint pulling free during gusty winds.

Note that four guys are used at the top, and four at the middle. While three are nor-

mally considered enough to hold any structure, four were used for simplicity in mechanical attachment to the antenna as described above.

The top guys and the middle guys are *not* anchored to the same points; anchor points for the two sets are offset 45° from each other. That is, top guys are anchored at points 90° apart, and middle-guy anchor points are located halfway between top-guy anchors. This staggering of the anchor points gives some of the sturdiness to be expected from eight-point guying.

To erect the structure, an assistant is helpful. Stand the structure against the side of the house, then lift it vertically (while standing on the roof) and carry it, still vertical, to the installation position. Have the assistant hold the antenna vertical (it weighs only a few pounds) while you temporarily anchor the middle set of guys. When they are tied in, the structure will be almost self-supporting. At this stage, you can install the bottom mount plates.

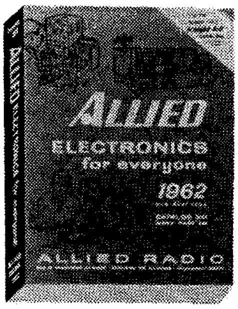
These plates are adapted from 2-inch angle brackets; the right angle built into the brackets is bent a bit wider open (just how much depends on the pitch of your roof) and the bolt holes (four per bracket) are enlarged to clear a ¼-inch bolt, before climbing to the roof. With the antenna in place, attach the brackets first to the roof, using ¼ by 2-inch lag screws. Then drill through the A-frame legs for ¼ by 1½-inch machine screws or aircraft bolts to attach the other part of the brackets.

The only thing left before trying the antenna out is to anchor the top guys, and to make permanent the anchoring of the middle set. This procedure is similar to any guy-wire anchoring procedure, with one exception: Glasline shouldn't be subjected to sharp bends. Use eyebolts and "thimbles" to guide the Glasline smoothly around the bolt, and secure the Glasline with a bowline knot, for complete freedom from worry about breaking guylines.

Now feed the coax through to the shack in any manner the XYL will okay (a ½-inch hole through the roof is ideal if permission can be wangled), hook the antenna up, and prepare to enjoy operation. For either DX or extended ground wave work at the frequencies for which it's cut, this antenna will give you good results. . . . K5JKX/6

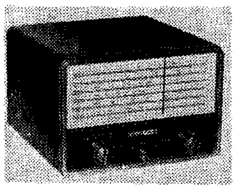
New Products

1962 Allied Radio Catalog



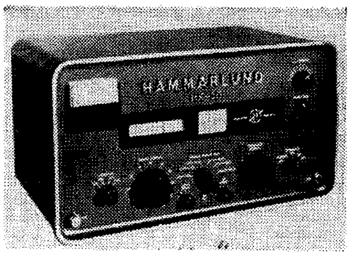
The 444 page catalog is now available for the asking. The ham section lists gear from over 45 major manufacturers plus Allied's own Knight brand 60 watt transmitter, receiver, G.D.O., etc. This is the most complete distributor catalog in the world and it should be on every amateur reference shelf. Drop a line to Allied Radio Corp., Chicago 80, Illinois or read their ad on page 80.

Eico Vfo



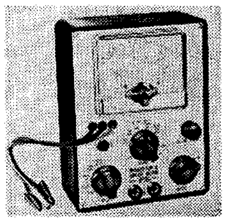
The model 722 VFO uses the Clapp circuit for stability and covers all ham bands from 80 through 10 meters. The power supply is built-in so you don't have to borrow power from the transmitter, possibly overloading it and at least giving you fits in hooking up the connections. The 722 has a spotting switch and can be operated by the transmitter by means of a built-in relay. Lengths are gone to in order to have drift-free operation: large air-wound coil, temperature compensating capacitors, high L-C, double-bearing tuning capacitor, and solid construction. Also a VR tube. Priced at $44.95 in kit form and $59.95 wired, ready to go. Write EICO, see page 5.

Hammarlund HX-50



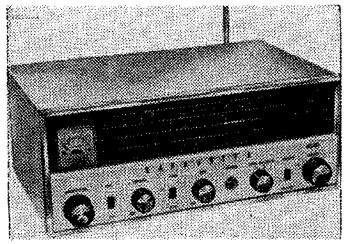
This is a new filter-type SSB transmitter, rated at 50 watts PEP. The VO is readable to oneF-half kc. Price $399.50. You'd better check into this one, looks like they did a nice job on design. Hammarlund, 460 West 34th Street, N. Y., 1, N. Y. Sorry, no ad to refer you to as yet.

Eico Transistor Tester



The model 680 not only measures actual transistor parameters, but is designed to be able to test all transistor circuits with its VOM ranges. 3½" meter with 50 ua movement. Details? Write EICO, see page 5. Priced at $25.95 in kit form, $39.95 wired and ready.

Lafayette HE-40 S-W Receiver



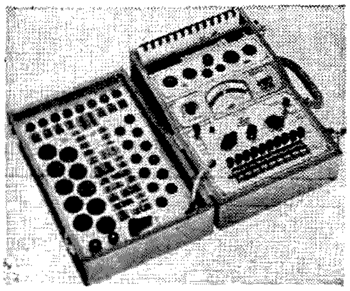
Priced at $54.50, this general coverage receiver tunes from 550 kc to 30 mc, covering all major ham bands. It has a separate bandspread tuning condenser, an "S" meter, BFO, and a built-in 5" speaker. It uses a built-in ferrite loop for the broadcast band, a 58" telescoping whip for the short-waves, and has connections for external antennas. 117v ac/dc. Write Lafayette for infor, se add on page 3.

New Book

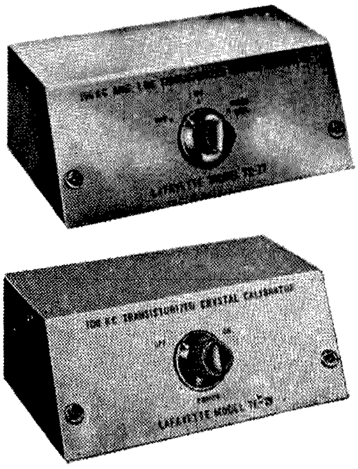
Basic Radio

John Rider has just published a six volume set of books which add up to a rather complete course on radio theory. The books are done in the usual Rider style of profuse illustration through drawings, photographs, and charts. Almost every page of every volume has one or two large illustrations. The entire course costs $13.85 in soft covers and $14.85 in hard cloth cover. The course covers: DC Electricity; AC Electricity; Electron Tube Circuits; AM and FM Receivers; Transistors; and AM and FM Transmitters. This set should be a fine adjunct to whatever you might suggest for the novice as a beginning text on radio. It might even help sharpen you a bit. John Rider, Publisher, 116 W. 14th St., N. Y. Sorry, no ad. Rider #197.

Seco Tube Tester



Tube testers are getting to be more like the dash of a jet-liner, what with all of the new tubes: nuvistors, compactrons, novars, UV-201's, European tubes, and such. The Seco 107A tests 'em all, dynamic mutual conductance test too, not just a look for shorts and open filaments. Price $149.50. A recent survey of ham shacks indicated that 14% of them boasted a tube tester. Here's your chance to join this exclusive group. If you do any test work or experimenting this gadget will be worth its weight. Write Seco for even more convincing data. Ad on page 54.



Lafayette Xtal Calibrators

TE-27 (transistorized, naturally) provides 100 kc and 1 mc signals and sells for only $18.95. It gives harmonics up to 54 mc. The TE-29 provides only 100 kc signals and sells for $11.95. Both are powered from built-in 9 volt batteries. More data? Write to Lafayette, ad on page 3.

Wall Chart

Stancor has an 8½ x 11 wall chart that not only covers up finger smudges, but also gives you color codes for their power, audio, output and *if* transformers. No charge. This can save you a lot of lost motion when you need it. Write: Mr. Cook, Stancor Electronics, 3501 Addison St., Chicago 18, Illinois. Sorry, not advertising yet.

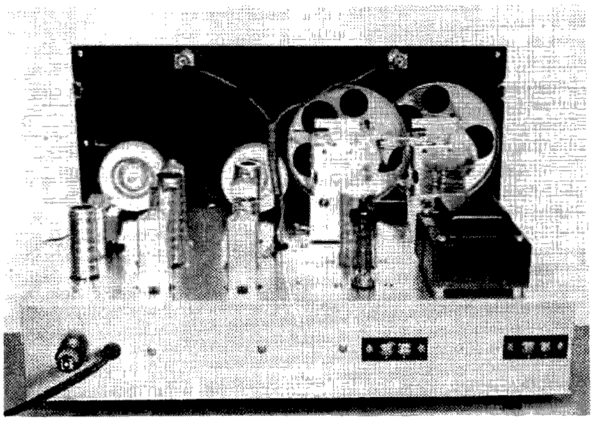
Variac

A note from the chairman of the board of General Radio Company pointed out that our article in the October issue of 73 on Variacs did not mention that "Variac" is a registered trade-mark of his company. The Teletype Corporation has the same problem.

73 Tests Knight R-55 Receiver

Don Smith W3UZN

THE new amateur is faced with quite a problem when buying a receiver. Of course it is nice to be able to walk into the store and buy one of the $600 ham-band-only receivers, but most of us have to start a lot more modestly. Look then, if you will, at the Knight R-55 receiver. This is a general coverage receiver, which means that even if you finally decide to go for one of the multi-hundred dollar communications receivers, you still will have plenty of use for this.



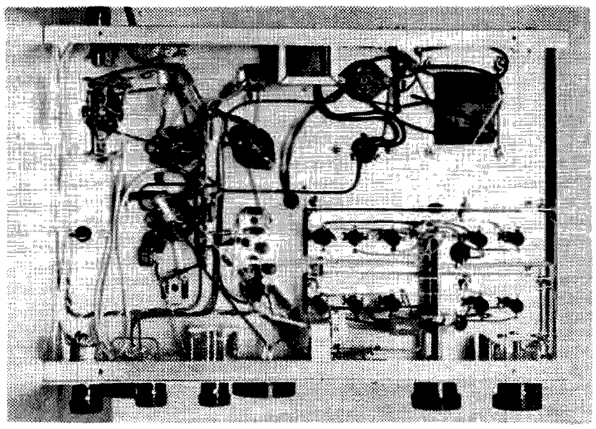
There are so many times when a general coverage receiver is needed that a ham shack certainly is incomplete without one. There are the obvious uses such as listening to the short wave broadcast stations, which can become a hobby all by itself. Or you can use it as a tunable *if* for a VHF converter . . . you can't do that with the bandspread receivers. WWV and CHU run interesting time programs, though I prefer the material broadcast by CHU, which seems to have a better program director. If you decide to try RTTY you will want a receiver to copy press and weather stations. Let's not forget the broadcast band either. Plus a hundred other uses if you do any experimental work at all, or engage in three-way contacts or cross-band contacts. You can quickly check for harmonics, parasitics, and things like that. You may get the idea that a general coverage receiver is necessary . . . it is.

R-55

Tuning ranges:	530 kc	to	1.9 mc	Band	A
	1.8 mc	to	6.3 mc	Band	B
	6.0 mc	to	14.5 mc	Band	C
	11.5 mc	to	33. mc	Band	D
	47 mc	to	54. mc	Band	E

IF frequency: 1650 kc
Sensitivity: 80 meters = 4uv 40 meters = 6uv
20 meters = 8uv
15 meters = 7uv 10 meters = 6 uv
6 meters = 10uv
Antenna impedance: 52 ohms
Power consumption: 60 watts @ 117 vac
Dimensions: 11" deep, 14¼" wide, 8⅝" high
Weight: 19 lbs.
Price: $67.50

The Knight R-55 has several advantages. First of all is that $67.50 price. It comes in kit form, but all the hard work is already done and the instruction manual is so simple that the rest is a breeze. It covers from 530 kc to 33 mc, which includes all of the short-wave broadcasting bands, and all of the ham bands from 160 through 10 meters. It also covers from 47-54 mc, which is the six meter amateur band. It is ac operated, using a power transformer, and has a separate BFO oscillator tube, fly-wheel tuning and an antenna trimmer for matching the receiver to your antenna.



The kit is a pleasure to assemble. All wires are color coded and cut to the right length. All resistors are mounted on cards with their part number printed so you can't make a mistake, even if you are color blind. The manual is full of clear diagrams and pictures to eliminate any question about what goes where or when to put it in. Figure about ten hours for the whole job.

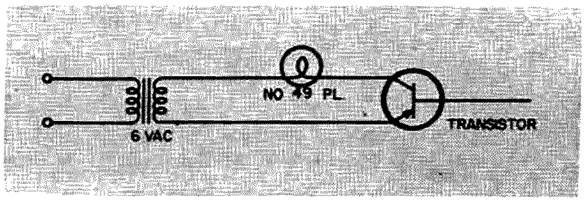
Now, about the results. I was surprised and pleased to use the R-55. The bandspread is ample on all amateur bands and both sensitivity and selectivity were fine. Even up on six meters there were stations coming in with

good signals. I suspect that one of those Nuvistor pre-amplifiers would help a lot there, though. On the other bands the R-55 was easy to tune and fun to use. For $67.50 this is quite a deal. . . . W3UZN

Using Old Transistors

Don't throw away your old transistors they may be useful in more ways than one. Usually when they burn out it is between collector and emitter. Sometimes base to collector is the bad section.

Here is the way I do it—start out with 5 v or 6 v ac to a pair of test leads and a pilot light such as a #49 something with low current drain so you will not ruin what is left of the transistor.



Check any two terminals of the transistor at a time collector to emitter, base to emitter etc. until you find two that pass current to the pilot light. Clip the unused wire and you have a diode for various purposes. If you don't have any results only thing to do is to throw the transistors away, it happens now and then. A word of caution—if for example the base emitter sections are okay and it is a P.N.P. transistor the base would be plus output and emitter negative etc. I have used them for relays noise limiters and the power type can be used for battery chargers—be sure to keep within voltage ratings.

. . . K8BYO

Radio Bookshop

Quiz

What is one of the best Christmas gifts you can possibly give to a ham, be he family or friend? That's right, a subscription to 73. How about second best? Got you that time! Well, running a close second you will find his eyes sparkle most when you let him unwrap a copy of the Radio Handbook (#40). If he already has that gem, then you can't go wrong with #37, #36, etc. Any of the Bill Orr books are great to read: #21-22-23-24-57-69. Get your order in right now, the books are all in stock for immediate shipment from Radio Bookshop, and we pay the postage!

1—ELECTRONICS & RADIO ENGINEERING—Terman. One of the most complete text books ever printed. 1078 pages. Theory, but easy on the math. **$15.50**

2—ELECTRICAL ENGINEERING HANDBOOK — McIlwain. Formulas, tables, circuits. A read handbook. 1618 pages. **$10.00**

5—ANTENNAS—Kraus (W8JK). The most complete book on antennas in print, but largely design and theory, complete with math. **$11.50**

6—VACCUM - TUBE CIRCUITS AND TRANSISTORS—Arguimbau. Designed for both beginners and engineers. Math kept to a minimum. Simple explanations of complex ideas. ouY'll know a lot more about radio after you read this book. 646 pages. **$10.25**

8—RADIO-TELEVISION & BASIC ELECTRONICS—Oldfield. Logical presentation and descriptive illustration make this an ideal book for the beginner. 342 pages. SPECIAL FOR CHRISTMAS. **$3.00**

9—LICENSE Q & A MANUAL—All the dope for commercial FCC licenses, 720 pages, become a professional for **$6.00**

13—REFERENCE DATA FOR RADIO ENGINEERS. Tables, formulas, graphs. You will find this reference book on the desk of almost every electronic engineer in the country. Published by International Telephone and Telegraph. **$6.00**

16—HAM REGISTER—Lewis (W3VKD). Thumbnail sketches of 10,000 of the most active and well known hams on the air today. This is the Who's Who of ham radio. Fascinating reading. Now Only **$2.50**

18—SO YOU WANT TO BE A HAM—Hertzberg (WTDJJ). Second edition. Good introduction to the hobby. Has photos and brief descriptions of almost ever commercially available transmitter and receiver, plus accessories. Lavishly illustrated and readable. **$2.95**

21—VHF HANDBOOK—Johnson (W6QKI). Types of VHF propagation, VHF circuitry, component limitations, antenna design and construction, test equipment. Very thorough book and one that should be in every VHF shack. **$2.95**

22—BEAM ANTENNA HANDBOOK—Orr (W6SAI). Basics, theory and construction of beams, transmission lines, matching devices, and test equipment. Almost all ham stations need a beam of some sort . . . here is the only source of basic info to help you decide what beam to build or buy, how to install it, how to tune it. **$2.70**

23—NOVICE & TECHNICIAN HANDBOOK — Stoner (W6TNS). Sugar coated theory: receivers, transmitters, power supplies, antennas; simple construction of a complete station, converting surplus equipment. How to get a ham license and build a station. **$2.85**

24—BETTER SHORT WAVE RECEPTION—Orr (W6SAI). How to buy a receiver, how to tune it, align it; building accessories; better antennas; QSL's, maps, aurora zones, CW reception, SSB reception, etc. Handbook for short wave listeners and radio amateurs. **$2.85**

28—TELEVISION INTERFERENCE—Rand (W1DBM). This is the authoritative book on the subject of getting TVI out of your rigs and the neighbors sets. **1.7**

32—RCA RADIOTRON DESIGNERS HANDBOOK—1500 pages of design notes on every possible type of circuit. Fabulous. Every design engineer needs this one. **$7.50**

33—WAVE PROPAGATION & ANTENNAS—Welch. Highly recommended by the propagation experts as the best Book on the subject. **$5.75**

36—CALL LETTER LICENSE PLATE—Regulation size license plate. Please give your call and the color of letters and background. **$3.00**

37—101 WAYS TO USE YOUR HAM TEST EQUIPMENT—Middleton. Grid-dip meters, antenna impedance meters, oscilloscopes, bridges, simple noise generators, and reflected power meters are covered. Tells how to chase trouble out of ham gear. 168 pages . **$2.50**

40—RADIO HANDBOOK, 15th EDITION—Orr (W6SAI). This is far and away the best amateur radio handbook ever printed. Over 800 pages. **$8.50**

47—PRACTICAL ELECTRONICS—Hertzberg (W2DJJ). Almost solid with pictures. Touches lightly on many aspects of electronics: ham radio, TV, transistor radios, hi-fi, microwaves, trouble-shooting, Novice station, antennas, test equipment, etc. **$2.50**

49—ELECTRONIC COMMUNICATION—Shrader. Huge book aimed at giving all information necessary for FCC commercial and amateur licenses. **$13.00**

50—MICROMINIATURIZATION—This is the standard text on the subject. Don't see how a company library can be without this one. Everything is going to have to be built smaller, you know. **$11.00**

52—HOW TO READ SCHEMATIC DIAGRAMS—Marks. Components & diagrams; electrical, electronic, ac, dc, audio, rf, TV. Starts with individual circuits and carries through complete equipments. **$3.50**

54—HAM RADIO HANDBOOK—Hertzberg (W2DJJ). This is a lavishly illustrated book to interest people in the hobby of ham radio. Tells how to get your ticket, select a receiver and transmitter, learn the code. Pictures and info on just about every commercial piece of ham equipment. Better than a catalog. **$2.50**

55—TRANSISTOR CIRCUIT HANDBOOK—Simple, easy tc understand explanation of transistor circuits. Dozens of interesting applications. **$4.95**

57—QUAD ANTENNAS—Orr (W6SAI). Theory, design, construction and operation of cubical quads. Build-it yourself Info. Feed systems, tuning. **$2.85**

58—ANTENNAS FOR CITIZENS RADIO—Orr (W6SAI) General coverage, mobile and directional antennas foi 27 mc. band. Build & tune 'em. **$1.00**

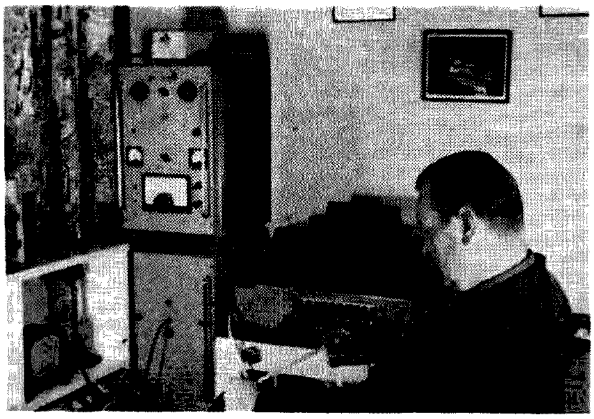
69—S-9 SIGNALS—Orr (W6SAI). A manual of practical detailed data covering design and construction of highly efficient, inexpensive antennas for the amateur bands that you can build yourself. **$1.00**

The Progress of RTTY in The United Kingdom

Dr. Arthur C. Gee G2UK

Hon. Sec. British Amateur Radio Teleprinting Group

DUE to a variety of reasons, RTTY has been slow to appear on the British amateur radio scene. While in the States the post-war years have seen a steady increase in interest in this aspect of amateur radio, it was not until a small group of enthusiasts decided in 1959 to really investigate the administrative and practical difficulties which were preventing RTTY getting started in the U.K. that any move towards its establishment was made.



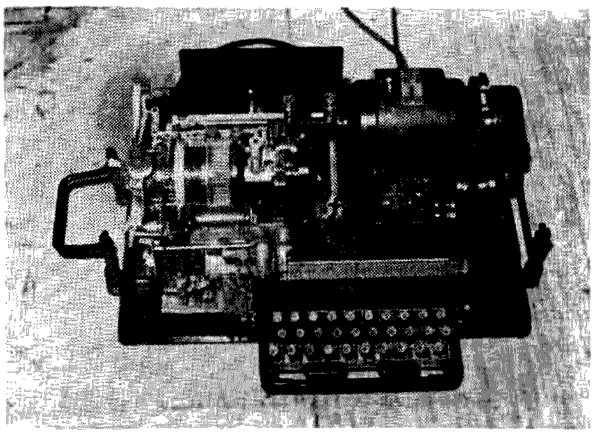
The author reading "the slip" from his Creed Type 3 Tape machine.

To their surprise, this group of enthusiasts found these difficulties far less formidable than they had anticipated. The G.P.O. proved most cooperative and raised no licensing difficulties whatsoever. When it came to obtaining teleprinters, it was soon found that provided someone was prepared to take a chance and put down enough money to purchase a "disposals lot" of twenty or thirty or so, suitable machines could be got at around the £3 to £4 mark.

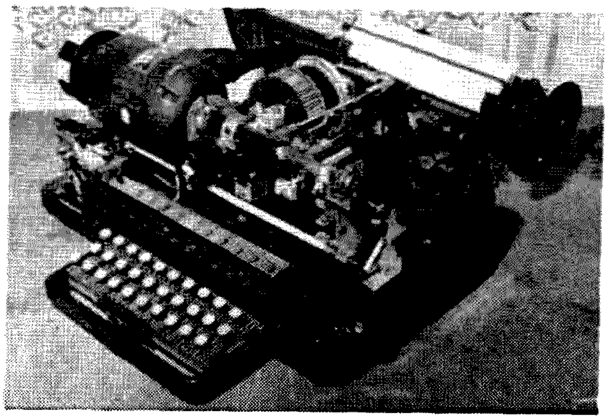
This was in fact one of the first steps which the group took. The teleprinters acquired were Creed Type 3 Tape machines and while they were more or less obsolete in present day commercial practice, they have proved eminently suitable for amateur use, being small in size, very rugged, easily dismantled and reassembled and not at all critical in adjustment. This type of machine is now used by the majority of active RTTY-ers in the U.K. It has its limitations it is true, the chief one being that its figure shift does not work into more modern machines and it has a very messy type-face inking system. However, these are but minor faults.

Once some activity started, it was surprising how news soon spread around of the availability of other suitable equipment. A number of the more up to date Creed Type 7 Page printing machines began to make their appearance in the shacks of the RTTY-ers. Some excellent T.U.s were discovered on the surplus market and were snapped up by the lucky few. The rest soon found suitable chokes and relays for adapting the various T.U. circuits published in various American radio journals available in this country. The mysteries of F.S.K. were soon explored and transmitters modified for this mode of emission and before long, the first RTTY QSO's were taking place on the 80 meter band.

Since then interest has increased rapidly and activity somewhat less quickly, but nevertheless very steadily. It is probably true to say that at the time of writing, most RTTY activity in the U.K. is on 2 meters. There is also some very consistent activity on 80 met-



The Creed Type 3 Tape teleprinter.



The other teleprinter used by British radio amateurs, the Creed Type 7 Page printer.

ers, mostly in the form of group nets and personal skeds. And there is a small but devoted band of dxers headed by Bill Brennan, G3CQE, whose signals are well known to many U.S.A. RTTY dxers.

Two monthly radio journals now publish RTTY articles and the RSGB Bulletin has just started a quarterly RTTY feature. The small band of enthusiasts who started things in the summer of 1959, has now grown into the British Amateur Radio Teleprinting Group, with a membership of over a hundred, many of whom are—in spite of its title—amateurs in other European countries, in Africa and in the States. The Group has recently been granted affiliation to the RSGB.

The future activities of the Group are obviously going to be full of interest. Currently, a RTTY Manual—English version—is being prepared. A regular News Sheet is circulated to members and committee members keep in touch by a Circular Letter sent round by the Hon. Sec., upon which members of the managing committee record their views on matters concerning the conduct of the group's affairs. Various social visits to places of a RTTY interest are being planned for the future.

In the writer's opinion, RTTY activity will be somewhat slow to "catch on" in the U.K. There are numerous difficulties which preclude all but the really keen from participating in this mode of amateur communication. One such, is the inability to type of all but a few!

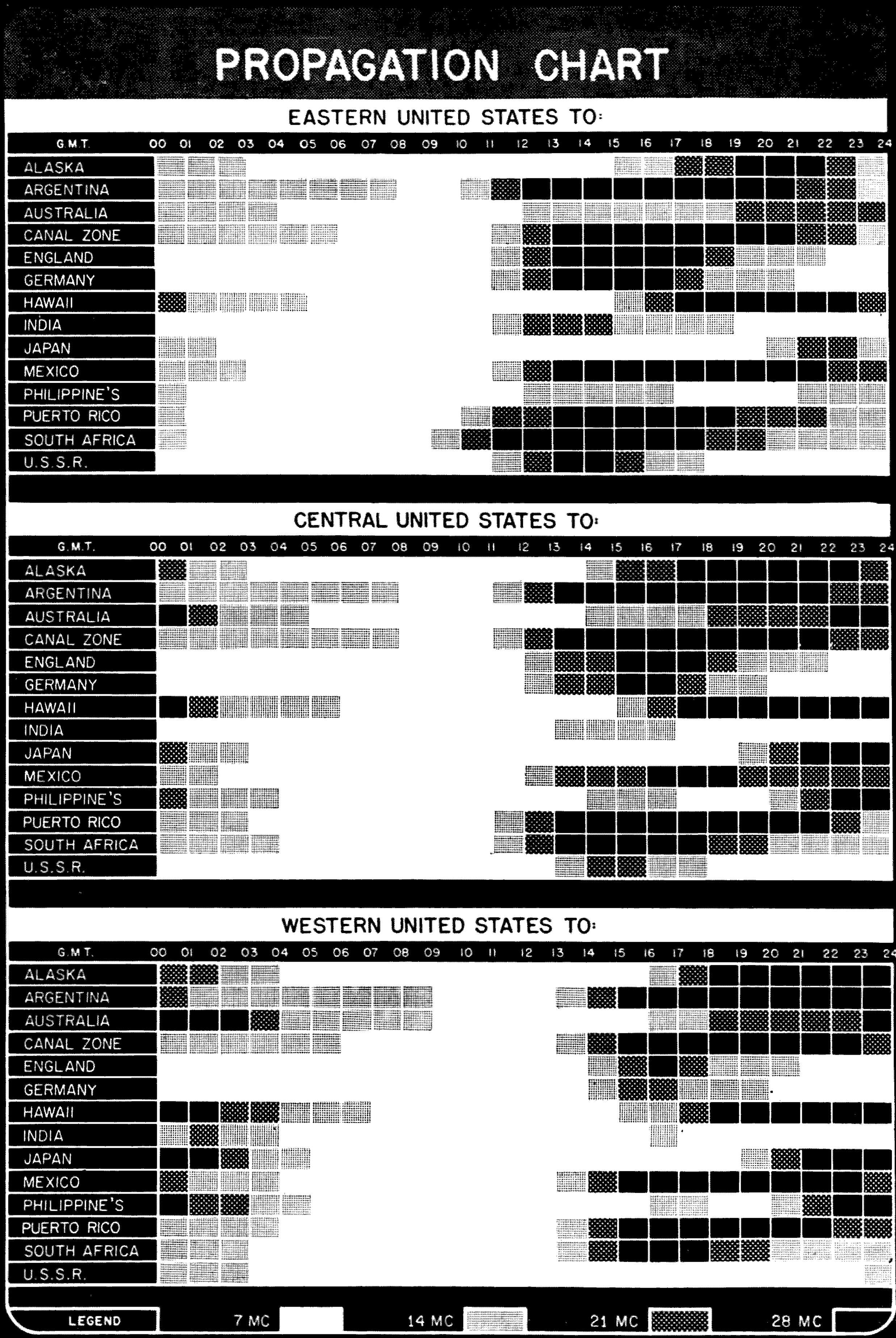
However, those who do go in for this latest phase of amateur radio activity are really dedicated to it! And amongst them there is to be found a brand of the "ham-spirit" which is truly delightful to behold! . . . G2UK

Letter

Dear Sir:

Does anyone reading this magazine have a proven, practical working audio derived, hang-type-AVC circuit installed in an HRO-50-T receiver giving step-by-step procedure? For this I will be truly grateful. Thank you.

Russ Smith W6ONK


PROPAGATION CHART
EASTERN UNITED STATES TO:
CENTRAL UNITED STATES TO:
WESTERN UNITED STATES TO:
G.M.T.
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PUERTO RICO
SOUTH AFRICA
U.S.S.R.
LEGEND
7 MC
14 MC
21 MC
28 MC

Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

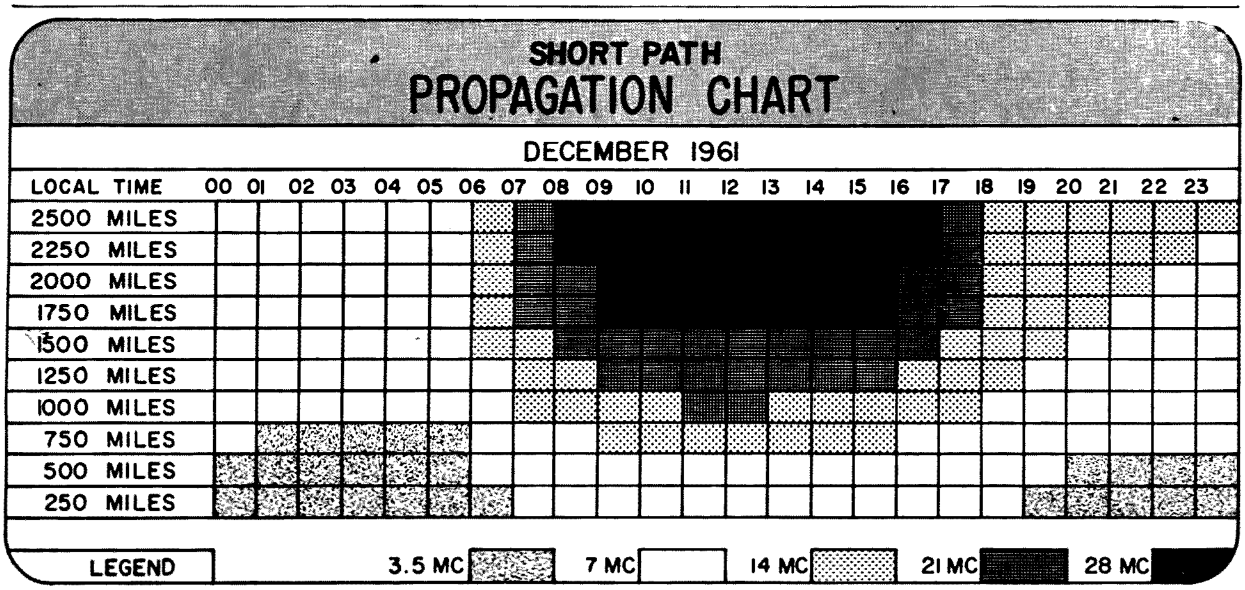
Advanced Forecast, December 1961

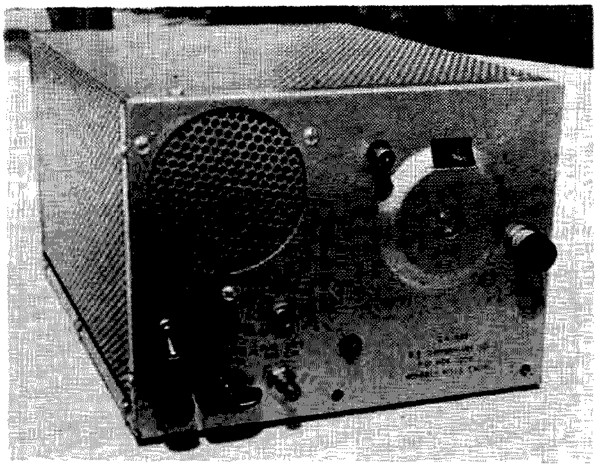
Good: 7-13, 19-31

Fair: 1-3, 5-6, 14-15, 18

Bad: 4, 16-17

The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earth's curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HBF's next to the 1250 ile listings will give the HBF to use and the time periods given will be the same at each end of the circuit. B.) To work the path New York to San Francisco (2,600 miles), the local time centered on the mid-point of the path will be 1½ hours later than at San Francisco and 1½ hours earlier than in New York (the time difference between New York and San Francisco is 3 hours). Looking up the HBF's next to the 2,500 mile listings will give the HB to use. In San Francisco subtract 1½ hours from the time periods listed for local time and in New York add 1½ hours to the time periods listed for local time.





Al Brogdon, W4UWA/K3KMO
RDI, Box 531
State College, Pennsylvania

73 Reviews

The QX-535 Receiver

THE R. E. Goodheart Company's QX-535 is a 200 to 550 kc receiver which, although useless for amateur frequencies "as is," is a very valuable addition to many communications receivers for use as a "Q5-er," or, with the addition of crystal converters, may be used as a high-quality communications receiver itself.

The QX-535 is basically a BC-453 receiver that has been repackaged in a trim, attractive case, complete with fused transformer-type power supply, speaker and all controls. The photo shows the physical arangement of the components inside the QX-535 case. Note that the tube compartment cover of the BC-453 has been removed. This, along with the use of a perforated case, insures adequate cooling of the receiver.

The circuit is a six-tube superhet with an *if* of 85 kc (with three double-tuned circuits at this *if*), and another tube in the full-wave rectifier circuit. The *if* transformers have an adjustable coupling consisting of a slug that may be reached by removing the screw-on caps on the *if* cans, and pulling a small shaft in and out. The coupling is at minimum in the "shaft-out" position, and this position should be used for maximum selectivity.

Condensed Specifications, QX-535

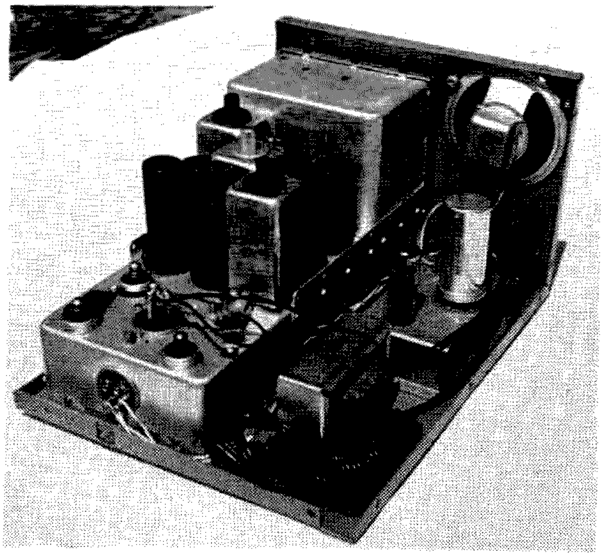
Price	$37.50 FOB Los Angeles (16 lb.), or $39.95 delivered in USA.
Tuning range	200-550 kc, with dial divisions each 10 kc.
Intermediate Frequency	85 kc with three double-tuned circuits.
Selectivity	2.0 kc at 6 db down, 6.5 kc at 60 db down.
Possible Use	(1) As a second-conversion unit, tuned to the receiver if, or (2) with crystal converters as a complete receiver.
Manufacturer	R. E. Goodheart Co., Box 1220, Beverly Hills, California.

By tuning the QX-535 to the *if* of your present receiver, then coupling it to the output of your receiver's *if* strip, the QX-535 serves as a "Q5-er," or outboard selectivity aid. Most receivers use an *if* at 455 kc, but the QX-535 may be used as a Q5-er for any *if* in the 200 to 550 kc range. This conversion to a second *if* of 85 kc with the QX-535 will give you a bandwidth of only 2.0 kc at 6 db down, and 6.5 kc at 60 db down. This means an AM (double-sideband) station will just barely fall within the QX-535 bandpass, and even close adjacent-channel interference will be reduced to a great extent. Offsetting the BFO to one side of the center frequency of the *if* will provide exceptionally good single-sideband and single-signal CW reception. Unfortunately, the BFO pitch control is not very convenient to adjust, being located near the rear and at one side of the BC-453 case. However, it is possible to make a minor modification to use the front-panel"align input" control as a BFO pitch control (reference 1).

When using the QX-535 as a Q5-er, it is quite impressive to use both the normal receiver's speaker and the QX-535 speaker, and tune across a few signals. As you tune across a given signal, you will hear it in the receiver speaker first, then it will come in and *pass through* the QX-535 bandpass before it disappears from the receiver's speaker. This, besides being an impressive demonstration of the QX-535's selectivity, may be a useful feature to use, for instance, in AM phone nets. The normal receiver may be used to listen for the net stations on their usual ten kc spread of "net" frequencies, while the QX-535 may be

used for added selectivity in rough copy conditions. This would also be of use in contest operation, using the main receiver to tune for calls, and the QX-535 to narrow the bandwidth for maximum interference-rejection.

In addition to the possibility of using the QX-535 as a Q5-er, is the use of the QX-535 as a tunable *if* with band-switching or separate single-band crystal converters. This has been described several times in amateur radio publications, and only brief details of this technique will be discussed here. For circuits and full information, check the references at the end of this article. This approach to a communications receiver for the ham bands is not only a very effective one, but it is inexpensive.



For instance, let us consider the case of a new ham who must limit his receiver budget to $100. You know as well as I what kind of performance he could buy in a commercial receiver for $100. Well, the new ham could take $40 of his budget and buy a QX-535. Then he could build a deluxe all-band crystal converter —even without a good junkbox for the components—for less than the remaining $60. And that ham would have a receiver, when he was finished, that would be very hard to beat as to stability, selectivity and sensitivity. W3SMV uses a homebrew converter with a BC-453 in this type of circuit and has the features of (1) stability from warm-up to within 400 cps, and after warm-up to within 20-30 cps; (2) bandwidth of less than 2 kc; and (3) sensitivity of less than one microvolt.

There is enough space left in the QX-535 case to build in a two-tube single-band crystal converter. One approach that could be used in making an all-band receiver out of a QX-535 would be to build an 80 meter converter inside the QX-535 case, then build an outboard all-band converter to cover 40 through 10 (or 6) meters, using the 80 meter range as a tunable *if*. Of course, the 80 meter converter should be provided with two crystals and a crystal

(Turn to page 76)

Letter

Dear OM:

W6SLK suggested that I write to you about A.C.A.R.N. because he said that you are not the kind that backs away from a new idea. So I am writing you in hopes that you will find this cause worth your helping out.

A.C.A.R.N. stands for Anti Communist Amateur Radio Network. The purpose of A.C.A.R.N. is to educate the radio amateur operator on the dangers that threaten the existence of their amateur radio hobby, as well as that of the nation as a whole.

It may be claimed by some, that anti communism is not a proper subject for amateur radio—that it is political etc. Nothing could be more incorrect. Communism has been ruled on by the U.S. Supreme Court as an instrument of a foreign government — not a political party. Secondly, Communism presents a very real threat to the existence of amateur radio. Communism is the enemy of all American institutions, including amateur radio, and is sworn to destroy them. Communism has declared total war on the American people. Radio amateurs must use their equipment to protect their hobby and their country from conquest on the installment plan.

All radio amateurs must give serious thought to the future of amateur radio and the continuing existence of the United States Government. Radio amateurs should acquire knowledge on what is happening to their country. The Communist noose is slowly but surely tightening. Unless we stop it, there will be a time when there will be no more amateur radio operating, no free speech and no liberty.

The above three paragraphs are the text of A.C.A.R.N. bulletin number 2 of October 28th. A.C.A.R.N.'s address is P.O. Box 558, Berkeley 1, California. All letters are answered and inquiries from licensed amateurs are invited.

Incidentally, Mr. Huntoon of the ARRL has turned thumbs down on this idea, terming it political etc. He refused my insertion of a 29 word ham ad on this network idea. However, CQ magazine did accept the ad.

I feel that amateur radio offers a large untapped potential for alerting the nation on the dangers of communism. The chips are down—our lives are at stake. I sincerely hope you will be interested in helping out. It would be great if you could give it a mention in your editorials. I would be more than willing to write a short column if you desire.

Here is an opportunity for you to get in on the ground floor of a good thing. I hope you will grab it. No other publication has been approached in this way—as yet. I am sending out frequent bulletins such as above, by cw automatic tape. Today I got a qso after the bulletin, with LA7RF/MM. He says A.C.A.R.N. should cover free world amateurs, as well as those of the U.S.

Wat sa OM?

F. Huntley W6RNC

Dear Fred,

Much as it pains me to miss the boat on getting in on the ground floor of a good thing, I'll have to beg off on this one. You are right on one count, I am not the type to back away from a new idea. . . . I am stepping up to the plate and taking a good swing at this one.

Fred, I'd say, offhand, that you have, singlehandedly, managed to ferret out, all by yourself, the most efficient way yet discovered to kill off our beloved hobby of ham radio problems. At the inception of that conference it was ing my editorials or you would not be offering this barrel of hemlock to the amateur fraternity.

Let me bring you up to date on current events. In 1959 a conference was held in Geneva to iron out the worlds' radio problems. At the inception of that conference it was the educated estimate of those involved that amateur radio would suffer serious deletions of the ham bands. The U.S.A. went into the conference in the poorest of bargaining positions: asking for nothing and hoping for the minimum number of cuts. The votes of most of the rest of the world seemed to be against us. The only unknown was the position of the U.S.S.R. and their controlled votes. When the U.S.S.R. backed up the U.S. position our bands were saved until the next conference, about three years from now.

Suppose you were able to enlist the help of amateurs to unleash a barrage of propaganda at the U.S.S.R. What would be the result? In all probability it would be just the same medicine they applied to the Voice of America broadcasts: intensive jamming. It seems quite likely that most of the jamming stations throughout Russia are being operated by radio amateurs. An attempt to blast through the Iron Curtain on the ham frequencies would merely see these chaps spending their leisure buzzing our ham bands instead of QSO'ing us and learning more about us. We are doing a much better job of corrupting Communism by just being ourselves and talking with the Russian hams than we could ever do with an overt attack through ham radio which would inevitably end in complete disaster for our hobby. Ham radio exists today in its present form be-

cause of the support of the U.S.S.R.

Further, after reading your letter carefully, I find absolutely nothing positive in it. There is no suggestion of what amateurs can do to help, only a jumble of emotional clichés and half truths. When you broadcast on our ham bands (where broadcasting is prohibited by federal law) that communism is the enemy of amateur radio, that communism has declared total war on the American people, and use hack phrases like the "noose is tightening" . . . "chips are down" . . . "our lives are at stake" . . . etc., then you are hurting us all.

It would be helpful to provide DX operators with an article explaining what can be discussed with the Russian amateurs and what can't. It could then go on to point out what information we could impart to them without causing them difficulty and still get the message across. How long would you sit still and listen to a torrent of emotion from a Russian amateur station?

My congratulations to John Huntoon and the ARRL for turning down your idea. I am sorry to learn that CQ is supporting your venture and I hope that they will think better of it before your ad gets into print.

. . . W2NSD

Statement of Ownership

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, JULY 2, 1964 AND JUNE 11, 1960 (74 STAT. 208) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF 73 MAGAZINE, published monthly at Norwalk, Connecticut for September 20, 1961.

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5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required by the act of June 11, 1960 to be included in all statements regardless of frequency of issue.) 15,166.

WAYNE GREEN

Sworn to and subscribed before me this 20th day of September, 1961.

AUGUSTUS F. PETERSON

(My commission expires March 30th, 1963.)

(W2NSD from page 4)

began to come in I could see that most of them were the same as you would also be seeing in the pages of 73. No one needs a buyer's guide around to tell them to send for a catalog.

The golden lining: much of the material submitted for the Guide is just what we like to have on hand to fill in the spaces between major articles in 73. Most readers want to have their articles run continuously and not jump to the back of the book, which means that we have to have a good assortment of small items on hand to patch things together. It is much more difficult to put a magazine together like this.

Europe

Those of you who have been following my editorial ramblings for any length of time may remember that I frequently get in references to the Porsche. I hasten to explain to the more cubical readers that a Porsche is a make of car, not a new transmitter. Ahhh, but what a car. I won't go into a long sales pitch on it, but I must explain that most of the well versed authorities on cars agree that the Porsche is the finest designed car in the world today.

It is only natural that the owners of these amazing cars should rally together into clubs where they could laugh with contempt at people who buy Cadillacs and Mercedes. The national club, the Porsche Club of America, has grown to some 2000 members . . . which is rather remarkable when you consider that there is probably only about 10,000 of the cars in the U. S.

Regional clubs hold monthly meetings where the technical aspects of the car are discussed and sports car films shown. They also organize events such as gymkhanas, rallies, concours, hill climbs, races, etc. The national PCA publishes a nice little monthly magazine and organizes a yearly trip to Stuttgart, Germany for members to visit the factory and buy new cars if they wish. Most of them do buy the car since it is over $1000 less at the factory than delivered in the U. S., and the shipping costs of getting it back plus duty on the used car are usually about half of that. Thus you get the best of transportation for traveling around Europe and still have a bargain priced car when you get back.

The flight came at the wrong time for me in 1958 and I missed it. I did the next best thing and organized my own personal flight over about a month later and picked up a car. I drove 4000 miles through Europe, visiting hams and talking to ham clubs as I went. You can be sure that I made it my business to be available for the 1959 trip. I conned Steve, W2OKU, who lives just a few blocks from me, into going on this one too. I already had

a 1958 and 1959 Porsche, so I really didn't need a third car. Fortunately I managed to talk Ed Bedersen, K2QWO into buying a new Porsche which I would pick up for him at the factory and gently break in on the German Autobahns. Heh, heh.

I was off on a rally in New Jersey and missed the cocktail party given by the U. S. representatives of the Porsche factory. Steve turned up and won the raffle, with the prize being a free flight back from Germany for his new Porsche via Lufthansa Airlines. Quite a prize.

The next afternoon two DC-7 loads of Porsche Club members, 185 of us (including a lot of wives), were on our way to Stuttgart. We were fed almost constantly all the way across. We arrived at the Stuttgart airport about 9 AM and found a champaign party waiting for us on the patio of the administration building. There they stamped our passports, accepted payment for the new cars and gave us all the necessary papers of ownership and for driving anywhere in Europe. Our luggage had been transferred to some beautiful German busses. Taking a few more gulps of champaign, we boarded the busses and were driven to a magnificent castle a few minutes away. There, as we rounded the balcony, was an amazing panorama: in the background lay the city of Stuttgart, and in the foreground were one hundred Porsches spread out over the huge lawn.

Each of us were called individually forward and were introduced to the mayor of Stuttgart and Ferry Porsche. We were then given an armload of gifts (wine, cute German dolls, scarfs, books, etc.) and escorted to our own car. There were mechanics there from the factory just in case everything wasn't exactly perfect. They weren't needed. One of them helped Steve put the top down on his convertible model. Once we had inspected our cars, looked over those of our friends, and taken plenty of pictures of the whole proceedings, we adjourned to the side of the castle where Lufthansa was treating us to a fine catered lunch.

The cars had been arranged in lines according to the hotel accommodations so it was simple for us to form lines behind factory cars and convoy to the hotels. Since no plans had been made for our dinner that night I rounded up Steve and Earl Grainger W2NXZ and headed for the TV tower which overlooks Stuttgart. They have a wonderful restaurant right up on top of this tower. We took the elevator up and as I got off there was Lothar Woerner DJ1BZ sitting in front of me. The last time I had seen Lothar was the evening just about one year before when we had dinner at this very spot. Lothar was more surprised than I for this was the first time he had been

(Turn to page 73)

Reader's Service

As mentioned last month, one of our local publishers has forced us to temporarily discontinue the service postcard in each issue. We'll try to have it back in the January issue for you. In the interim please either use this blank or make one of your own and send it in. Write your name and address in the small square, put in the name of the advertisers that you would like further information from, and we'll cut out the square and send it along for you. This enables you to send in a subscription or gift subscription at the same time in the same envelope. Heh, heh!

12

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(W2NSD from page 71)

back since our dinner a year before. We had quite a QSO. Incidentally, the food is terrific there and very reasonable by U. S. standards.

Breakfast comes free with the hotel room in Europe. After breakfast we all drove to the Porsche factory and were given a guided tour. You really have to see it to believe it. Every part of the car is fitted carefully by craftsmen. They take extraordinary care in putting it together. We were all snapping pictures right and left. Be careful when you visit me or else you may see the whole trip, including every corner of the factory, in detail.

There was a cocktail party midway in the tour, complete with a snack and more gifts (thermometer, picture album, etc.). The tour ended in the accessory sales department where we were able to indulge ourselves with Porsche ashtrays, handbags, scarfs, cigarette lighters, badges, decals, spare parts kits, etc. From there we drove to a nearby racetrack which had been rented for the day. After an outdoor lunch of hot dogs, potato salad and beer we tried out the track.

This was my first experience on a racetrack and I really put my foot down hard. All of a sudden I was in a double hairpin turn and spinning around! I got straightened out and took it much easier until I got the feel of the track and the Michelin tires, which were new to me. The track was about five miles around and had a couple places where I could open the car up to about 110 before I had to brake for a turn. After a half dozen rounds I was familiar with the track and keeping up a reasonable average speed. I stopped and talked Steve into going around with me once . . . heh, heh. He'll never forget that ride. The factory had their most famous drivers there with the Porsche racing cars and were giving the hardier souls a memorable experience around the track. I was having so much fun seeing how fast I could go without wrecking Ed's car that I missed the free rides.

That night the factory gave a dinner for us all and gave away a huge pile of door prizes. I won an ashtray, but watched others win watches, FM radios for their cars, etc.

We had the next two days to ourselves, being due in Locarno, Switzerland (down near Italy) three days hence for the International Porsche Club meeting. Most of us headed for Zurich as the first stop. I paid a visit to the Hanhart factory, where they make the Hanhart stopwatches, in Schwenningen. Hanhart is the largest selling stopwatch in the world.

As a dealer in Hanhart watches I was given a friendly greeting. When I got interested in sports car rallying I did a rather thorough

(Turn to page 74)

(W2NSD from page 73)

investigation of stop watches and found that the best one by far was the Hanhart. There seemed to be no dealer setup in the U. S. so I imported the watches I wanted for myself. It wasn't long before other rallyists wanted them too and I found myself in business . . . selling at cost. Some business! Everyone liked them very much for they were easier to read, kept better time, and were less expensive than other watches.

After looking over the latest Hanhart watches I drove on to Zurich and left my car with the local Porsche dealer for the 300 mile inspection. Hotel reservations had been made by the PCA. I shopped around town during the afternoon and then took a cab to the garage. On the way I spotted Steve, obviously lost. I left the cab and directed Steve to the Porsche garage. My car was done, so we left his and drove back down town. Earl had gone to visit an HB9 chum of his some 50 miles away so Steve and I sight-saw and had a fine dinner.

I drove Steve back out to the garage the next morning, but his car still wasn't finished. No wonder, I believe that 80 out of the 100 PCA Porsches had been brought in for inspection and service. Even with the help of a group of mechanics from the factory they couldn't keep up with that number of cars. I couldn't wait for Steve if I was going to make it to Liechtenstein and then down to Locarno all in one day. I crossed the border into Liechtenstein by noon and found the tiny Curta factory by 1 PM.

The Curta is the world's smallest computer. We use it for rallying and find it far better than even a Monroe Computer. Indeed, I did at one time have a Monroe mounted in my Porsche. I had become a dealer in Curtas for the same reason as the Hanhart watches . . . it was the only way to get them in the U. S. Beware of the Curta though, for every ham that I've shown one to, has immediately wanted one for himself.

After taking some pictures in the Curta factory (mostly automated), I drove a couple miles north to Austria for lunch. Porsches had been passing me every few minutes on their way to Locarno, so I fell in behind a pair of them, one with a Swiss license and the other Austrian. They both obviously knew the road quite well for they were doing over 100 on the stretches and slowing down to 70 on the hard curves. No car but a Porsche could have done it. I managed to keep up with them, but it was hair-raising. I watched the exact spot where I saw their tail lights go on and braked there . . . sure enough I was able to make it through the turn without careening into a chasm. Traffic was slight and they drove as though there was a possibility

of a car appearing around the turns. Madmen.

Everyone should have a chance to go over a Swiss mountain pass in a Porsche before they depart this world. There is no experience like it. We whizzed across the San Bernardino Pass, with its hundreds of switch-backs, sliding through every turn. We passed a Cadillac on one turn and I felt a moment of pity for the fat cigar smoking chap inside who had to stop at almost every turn and back up once or twice to get around. The madmen finally stopped for gas and I continued on at an easier pace.

Next month, if anyone is really interested, I'll carry on with the International Porsche Club meeting in Locarno, my visit with I1LOV, and the I.T.U. conference at Geneva.

All this was brought on by the announcement of the P.C.A. that the 1962 trip will go over in April. Now that I'm married, I sure would like to take Virginia over and show her all of those things that I enjoyed so much. If it is possible to get away we'll make the trip. The cost is about half the regular fare, so we'll probably be able to swing it. I know all the tricks for getting along in Europe for under $5 a day for each of us, which helps. I know that a disproportionate number of hams are Porsche owners (I know of at least ten), so maybe some of you'll be with us this time.

Regarding Subscribing

You may have noticed that most magazines make a big fuss and try to get you to subscribe. There are good logical reasons for this. Number one reason is that most advertisers seem to put a lot of store by the number of subscribers a magazine has. I should think that the total number of copies sold per month would be more to the point, but they always ask about subscriptions. Then there is the chance that you might miss a few copies during the year due to the newsstand being sold out or your not liking a particular issue. There are a page full of other logical reasons. All in all, it is pretty important to us that you subscribe.

Granted that it is quite a logistical problem to round up a subscription form, an envelope, a pencil and three dollars all at one time. We are desperate. We will cheerfully accept any scrap of paper in lieu of one of our own blanks. We will accept anything negotiable in payment: cash, check (on a U.S. bank), money order, foreign currency, stamps, etc. We are holding our subscription rates down as long as we can, but it is getting close here and they may have to go up soon.

(QX1535 from page 67)

switch for complete band coverage, tuning perhaps 3500-3850 and 3700-4050 kc. This would cover all of the ham bands up to ten meters, where switched crystals should be again provided in the outboard converter for complete band coverage.

The QX-535 as a basic unit could prove to be a useful addition to almost any receiving set-up. The references to follow include several different ideas various hams have had on how to use the BC-453. The QX-535 may be used in all of these ways, and is nice to use since it not only is complete with power supply and controls, but is a nice-looking package, and, far from being the least consideration, quite inexpensive.

. . . K3KMO

Letter

Dear Wayne,

In the plastic bag you will find some braid which has been soaked in flux and oven dried. This may not be new to you but it was to me and I have never seen anything about it in any of those other pubs., so I would like all the people and hams, too, who read your magazine to know about it. The deal is this; if you need to repair some gear, especially surplus equipment, lay an end of the braid on the solder joint and apply a hot solder iron to the braid and watch the braid soak up the solder! Brush the joint with some solvent and it will shine like new. Try it. I use this method to make old tube sockets "New."

I am taking advantage of your three year offer before the price goes up like on the last job you had.

Floyd K. Pevoto K6JHT

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Alden 65
Allied Radio 80
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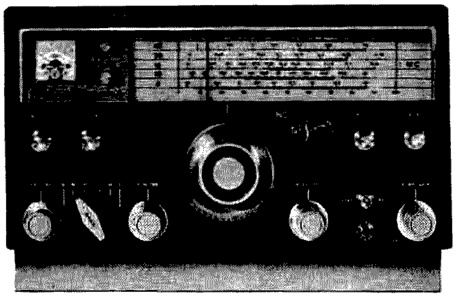
Barry 55, 76
Burghardt 55
B & W 32, 59
Call D Cal 55
Candee 69
Centimeg 15
Central Electronics 19
Clark 57
Clegg 23
Columbia 67
Cornell-Dubilier 4
Craftronics 20
Cushcraft 57
Dow Key 53, 77
EICO 5
Elliott 49
Elmac 53
Epsilon 75
E-Z Way 50
Gam 21
J. J. Glass 73
Goodhart 71
Graham 78
Ham Boards 57
Ham Kits 59
Ham TV Book 77
Hi-Par 63
International Crystal 7
Irving Electronics 55
KTV 73
Lafayette Radio 3
Miller 53
Mini-Products 70
Multi-Products 53
National Radio .... Cover IV
Neil 72
Newtronics .... Cover II
Novelties 76
Penwood Numechron 77
Petersen .... Cover III
P & H 51
Radio Bookshop 60
Reyco 78
R-W Electronics 76
Seco 54
Shure 29
Skylane 77
Space Raider 17
Sprague 32
Springfield Enterprises 51
Subs for Clubs 55
TAB 79
Tapetone 49
Technical Manuals 75
Technical Material Corp. 13
Telrex 59
Texas Crystals 74
Tri-Ex 31
U. S. #1 Electronics 75
Waters 11
Western Radio (Nebraska) 78
Western Radio (San Diego) 68

1



NC-270

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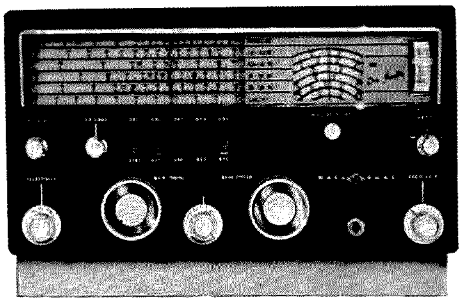

NC-190

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NC-155

NATIONAL'S TRIO OF PACE-SETTERS

Here are the three new receivers that are already setting the pace for the industry—Each offerin you more solid performance in its price area than you will believe . . . until you tune one. We invit you to try all three—then select the one that best suits your requirements.

NC-270 . . .
Precision double-conversion 80 through 6 meter amateur receiver featuring rock-like stability an unchallenged VHF performance. Five degrees of variable IF selectivity, including selectable SSB wit product detector, 1.0 uv sensitivity, 60 db deep T-notch filter, built-in 100 KC calibrator, crystal controlled 2nd converter. More features than any other receiver in its price range. **$279.95 am. net.**

NC-190 . . .
The 540 KC—30 MC general coverage receiver that tunes like a ham-band-only unit. 1.0 microvo sensitivity, double conversion with five main tuning ranges, 5.0 KC, 3.0 KC, and 600 cycle variable I selectivity, full SSB/CW AGC and product detector, 60:1 bandspread vernier drive and National' exclusive dial selector, providing instant choice of calibrated amateur or foreign broadcast band **$219.95 am. net.**

NC-155 . . .
National's newest—A double conversion 80 through 6 meter ham-band-only receiver offering super performance completely out of proportion with its price. With its basic design derived from the famou NC-270, the NC-155 features 5.0 KC, 3.0 KC and 600 cycle variable IF selectivity, full SSB/CW AGC an product detector, and a velvet 60:1 dial drive that makes SSB signals as easy to tune as AM. 1.0 micr volt sensitivity on 6 meters, too! **$199.95 am. net.**

NATIONAL RADIO COMPANY, INC. MELROSE 76, MAS

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